RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

BRIDGES - BUILDINGS - CONTRACTING - SIGNALING - TRACK

New Series, Vol. VIII
Old Series, Vol. XXVII | *Chicago* | DECEMBER, 1912 | *New York* | No. 12

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Whether in cut or fill, on right of way or siding, handling dirt, coal, ashes, concrete, gravel or rock, **are Standard** and make for efficiency.

At What Average Shovel Load Can Your Men Do the Greatest Amount of Work per Day?

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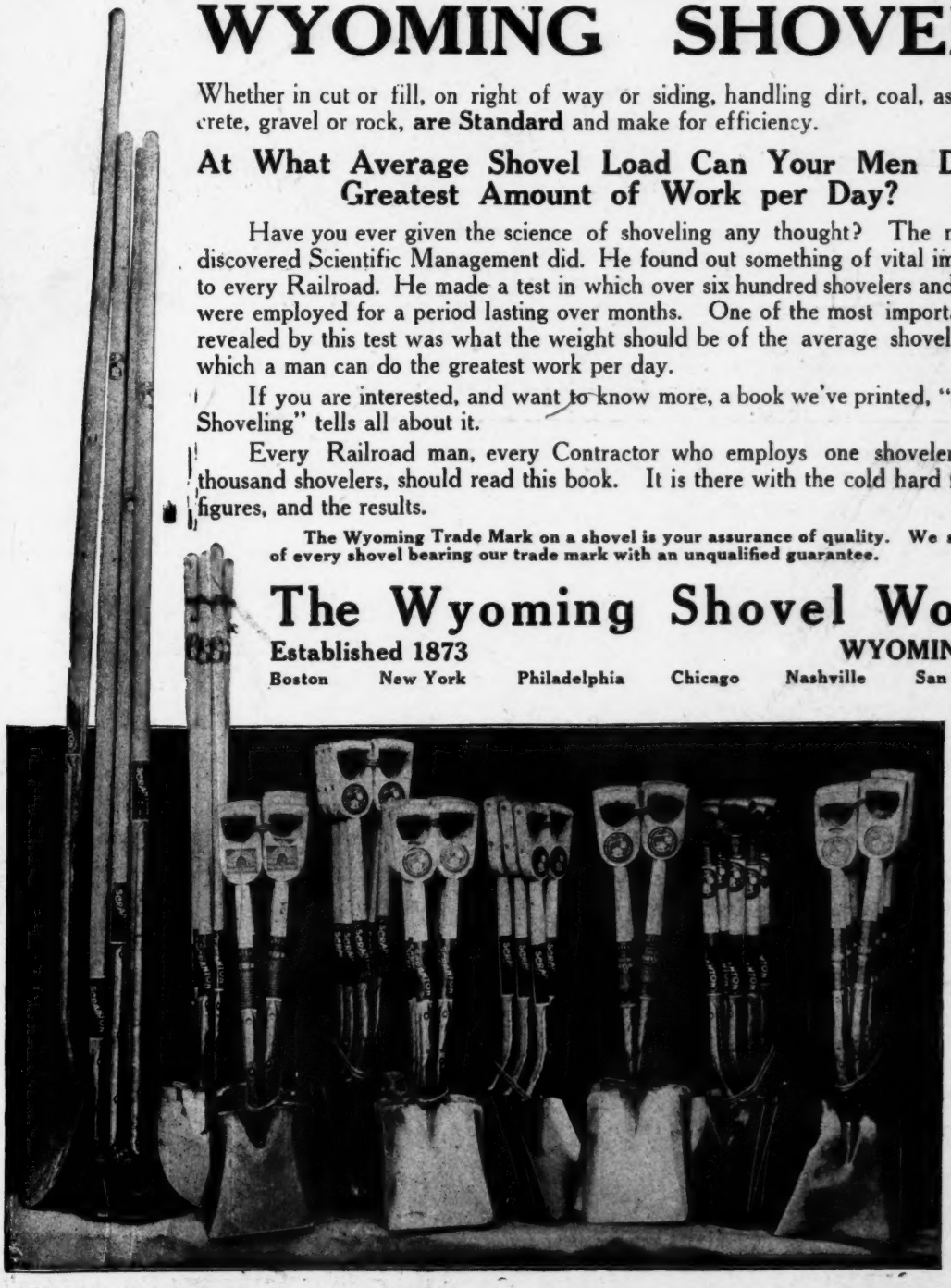

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Hubbard track chisels are made of correctly tempered crucible tool steel. They will **not** chip off with the first blow of the spike maul.

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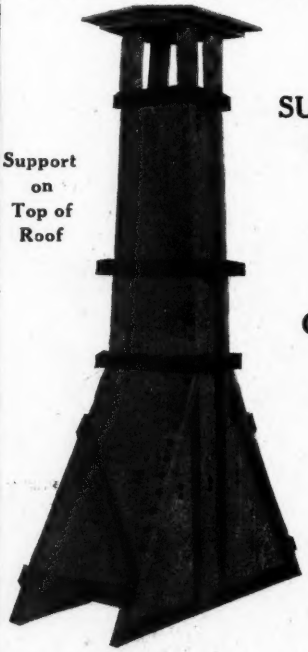

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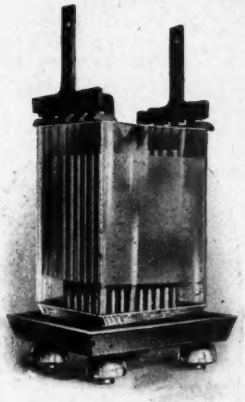

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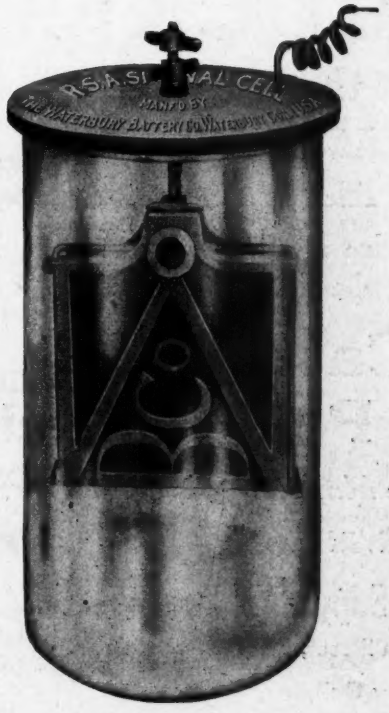

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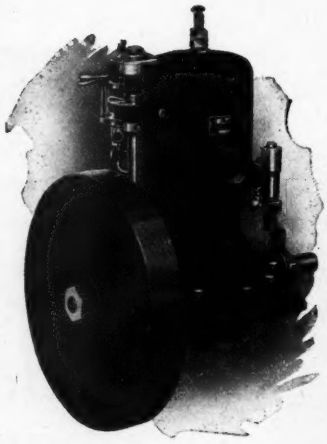

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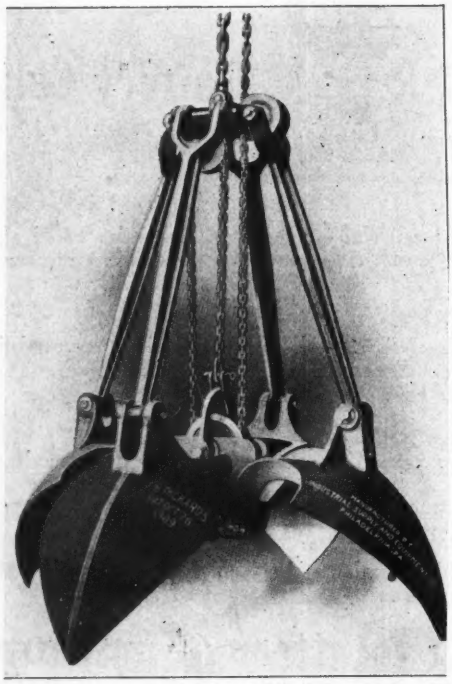

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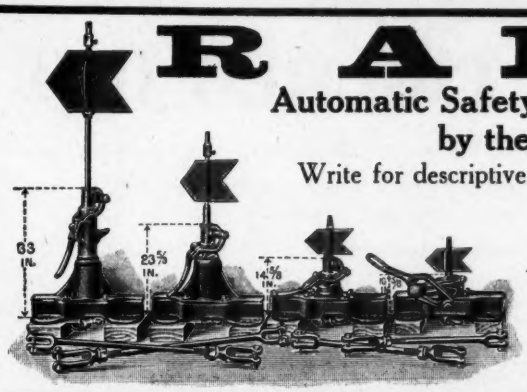

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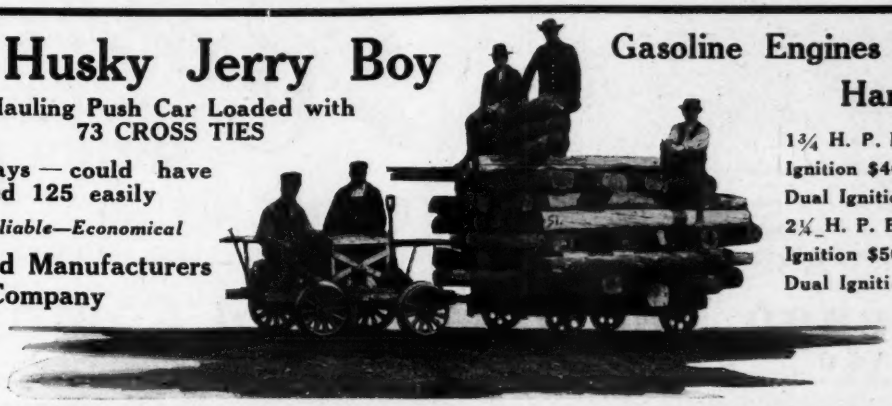

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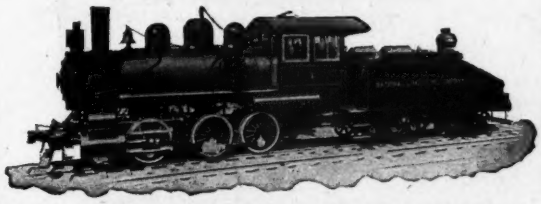

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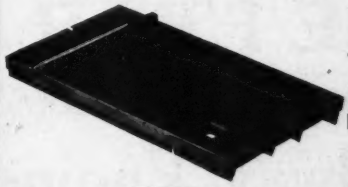

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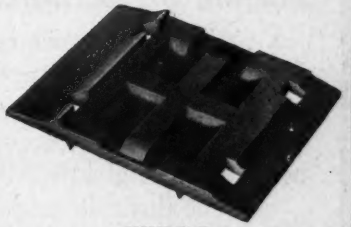
Flanged and Flat Bottom

Our Catalog Describes 20 Types of Tie Plates



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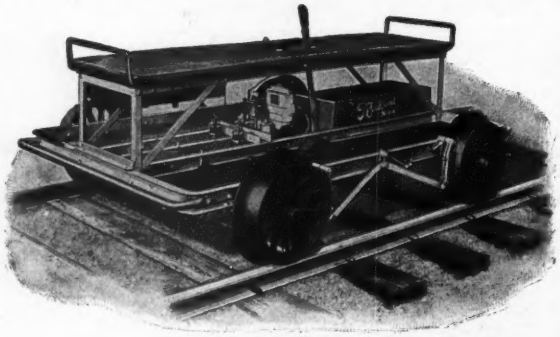

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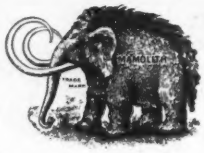

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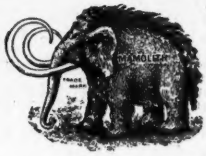

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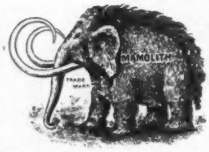

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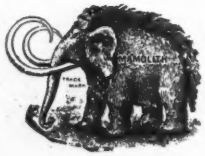

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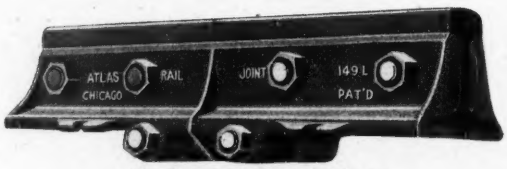

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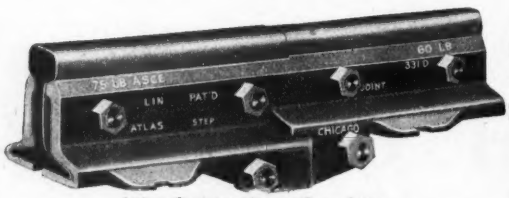

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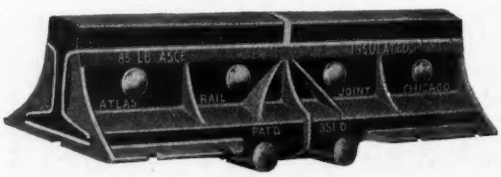

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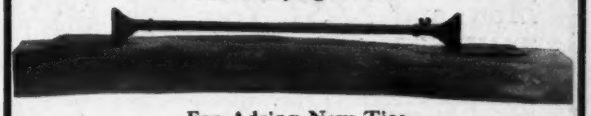

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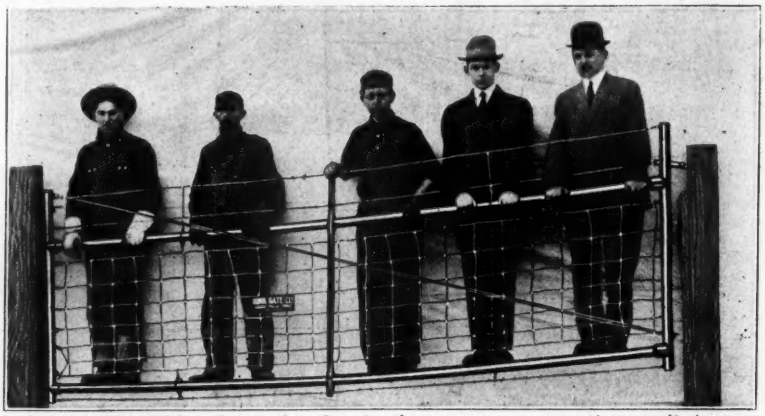

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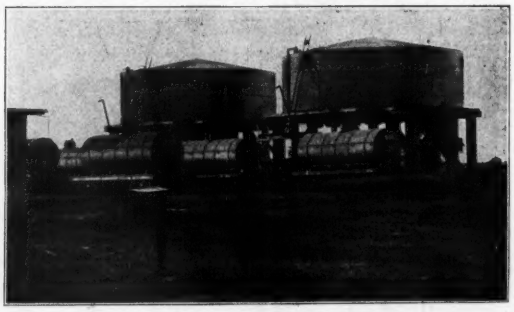

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New Series, Vol. 8
Old Series, Vol. 27 — Chicago, December, 1912 — No. 12

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Fair Dealing with Each Railway Employe.

AN ABUSE which is somewhat common on railways is that of appointing a successor to a man, and then allowing him all help, material, improved tools and equipment to enable him to make a record; whereas possibly the former man was denied all aids of this kind. Any fair minded man must admit that such a procedure does not establish the relative abilities of the men. And again many times one man will struggle along without assistants carrying a heavy overload of work, and possibly fail to keep things moving properly at every stage of the work, and when he is discarded the work will be divided up under several men.

Two or three ordinary men, if they tackle the job with a real intention of making good, should, of course, make a better showing, providing they are subject to a strong central authority which prevents conflicts. The former man may have had ability much above that of the men who succeeded him, and still be unable to make tag ends of the work proceed with machine-like precision, simply because some small and unimportant details could not be given great attention without detracting from the main features. Is the work cheapened in the end, and has the deposed man been given a fair show?

A good many concrete instances of such a policy might be given. Recently a superintendent of a very large division was "assigned to other duties" and two superintendents were appointed in his place, with headquarters 75 or 100 miles apart. Simply making two offices instead of one, probably reduces the time in covering the division very considerably and gives the officials probably a third more time to cover one-half the territory.

A good many of these abuses are directly due to favoritism. An official will sometimes take a dislike to a certain man because he has a friend who he would like to see in that position. He is too dishonorable to discharge the man without cause, as that might be brought to the attention of his superiors resulting in himself being called to account. So he schemes to overload the man with work, refuse necessary material, equipment, and tools, and to delay the work in every way possible. Thus he obtains an excuse for his dismissal, and presents the position to one of his friends whom he provides with everything the other man had, as well as those he lacked.

A crooked deal like the above will accomplish the end desired in most cases, but in the end such methods are bound to result in raising the suspicions of the higher officials. And if they are of the broad, fair minded type, and we are glad to acknowledge that the great majority are, the man who uses such tactics will be discredited, and forgotten when promotions occur.

Compensation on railways is hardly up to the standard of compensation for similar work in other industries and for this reason the railways should be particularly careful to give every man, even to the lowest paid laborer, a square deal and a show to make good and receives advancement if merited. And another reason that no employe's animosity should be incurred by unfair treatment, is the opportunity

afforded such a man for doing serious damage to railway equipment—a danger difficult to guard against on account of the large territory covered by the railway tracks and facilities.

Efficiency Engineering vs. Organization.

A GREAT deal is being said about efficiency engineering and many claims have been made of great economies effected by the efficiency engineer. Some very exaggerated statements have in some cases been credited, and efficiency engineering has gained a great reputation with some people who believe the results attained are marvelous. The latter was especially true when the profession was in its infancy and when little was known of the methods followed.

Efficiency engineering includes as a feature a detailed study of the motions made in doing certain work, and a resulting recommendation as to the number of moves to make, and the proper way to make them in order to give higher efficiency. This idea is simply the track man's idea of "organization" carried out in a more detailed and methodical manner. In organizing a large gang, your first class track foreman is on the alert at all times to devise ways and means for facilitating the work by properly placing his men. And he is obliged to show awkward or inexperienced men the correct ways, or better ways, for doing the work. He plans the movements of the whole gang in such a way as to cause the least delay and least number of moves in covering a certain territory. The efficiency engineer is able to accomplish much more because he has nothing else to do but to watch and devise the improvements.

The value of organization is not fully appreciated by all track men, and is badly misunderstood as respects track work by those unfamiliar with the subject. The word not only designates placing men so that they will work harmoniously and advantageously, but it implies also that each man be placed at the work for which he is best fitted. One can readily see that this result cannot be immediately attained, but it is the idea aimed at and not only must the physical makeup of the man be measured, but a man's disposition, age, willingness, natural skill, and familiarity with the work must also be considered. A man who shows a disposition to lag will many times hold his own against a more willing workman if the work is arranged on a competitive basis. For instance, if a laggard is placed where he must rehandle a certain amount of material which is being passed to him by another, he will, in many cases, do enough work to keep from being "snowed under."

There is a quite general impression among people inexperienced in handling labor, that anybody can handle an excavating gang in other words "anybody can dig a hole"; but the understanding of organization and methods, in this case, is as essential as in track work. And there is room for serious error even in estimating the comparative amounts of work being done by two men working side by side. A study of the work, or of the organization, will many times, lead to a complete rearrangement of the laborers. The first class foreman on excavating has the widest latitude for exercising the methods of the efficiency engineer, and he has been doing it to a great extent.

The mediocre or poor foreman has little idea of organization from a practical standpoint. He may use it strongly as a talking point, but fail to put the principles to use in his work.

With the advent of the efficiency engineer into a business, (a railway organization if you like) one type of foreman is bound to disappear. This type is the one that holds his position by putting up a bluff and making a great noise on the work. Such a man will many times convince his superior that he is doing an immense amount of work because he is making a great noise about it. He gets a reputation of being a "hard man on laborers." He works on his superior officer to convince him of his (the foreman's) ability, with a tact and judgment, which if applied to the work of the gang, would probably produce gratifying results. The quiet, observing man who tends to the business of running his gang, and is not constantly attempting to get in right with the "boss," usually shows consistent and permanent results. And in addition he is a man who can generally be depended upon absolutely in the many emergencies which are bound to occur.

Eliminate the Interpreter.

NEARLY ALL practical track men, roadmasters, supervisors and foremen, are agreed that the interpreter, far from being a help, is a positive hindrance in any gang, however green. The opinions of men writing for the technical publications as well as committee reports submitted to the associations investigating the labor subject uphold this statement.

The interpreter is primarily a grafter. He arranges with the railway company to furnish a certain number of men, with the stipulation that he shall have charge of the men as interpreter. Frequently he also specifies that he shall have the privilege of boarding the men. While all these arrangements are being made, he is profuse in his promises to obtain good men and see that they do a fair day's work. But how does he respect those promises? In every case we have seen or heard of, the interpreter changes front when he gets on the job. In order to hold his authority over the men he tells them to "take it easy." He organizes the gang into a union in order to keep the foreman from firing any man. His main object in that, however, is to get the support of the men and prevent the foreman from discharging him. The graft which he takes from the men, he can explain, he is more than earning by lightening the labor and holding jobs for all the men.

Since practically all those directly concerned with handling labor are agreed that interpreters are a hindrance, it should be an easy matter to entirely eliminate interpreters by concerted action, unless these men are being upheld by some of the officials. Whether it is true that labor agencies and interpreters have worked with the approval of officials who have allowed them exclusive right to furnish men (it is usually assumed for a consideration) such a belief has been credited in a number of cases.

If the interpreter and the labor agent are not upheld by any of the railway officials for personal reasons it should be possible to work an immediate improvement in labor conditions by an agreement among a number of railways to eliminate the interpreter. Such a movement should only need a single high official as a sponsor in order to make it a complete success.

LOCOMOTIVE FUEL CONSUMPTION.

Editor, Railway Engineering: I have noted the letter of J. G. Van Zandt in your November issue, referring to my article on "Locomotive Fuel Consumption," also to a constant formula for resistance as adopted by the American Railway Engineering Association.

As chairman of "the committee which influenced the adoption" of that formula, I desire to state that the conclusions as adopted and shown in the Manual of 1911 with reference to resistance were based on results obtained from a large number of dynamometer tests on different railroads, each of the tests covering as much or more data than that shown in Bulletin 43 of the Illinois Engineering Experiment Station. The tests and analyses of the records were made by men as familiar with the processes of analyzing the same as were those who made the Schmidt tests.

No criticism of Prof. Schmidt's analyses of the tests on this particular division is intended, and I am not surprised at the results which he obtained. The Chicago division on which his tests were made is an extremely busy double track road with a number of heavy and fast passenger trains daily.

An engineer dislikes to publicly criticize track conditions on any road, as most of us realize that we have "glass houses" on our own lines. However, the bulk of Prof. Schmidt's tests were made in the spring months, at a time when track is in its worst condition, and when there had not sufficient time elapsed to place it in even a fair average condition.

Furthermore, it is questionable whether a force of one man per mile of track on a road laid with angle bars, and with busy traffic, can maintain this track in a good condition of line and surface. We know of similar divisions of heavier rail and modern rail joints averaging over 50 per cent higher force.

To those who traveled over this track at about the time of Prof. Schmidt's tests, the fact was evident that the joints were far from being in good condition, and the Illinois Central has since recognized this point and is using an improved type of joint much stiffer than the angle bar. Any imperfections of line and surface will have a tendency to produce higher draw bar pulls at the increased speeds, and in some details the maintenance of equipment may produce this effect, but in track with sufficiently stiff rail and joints, and maintained in condition for passenger traffic, no practical increase in freight train resistance is noted within the limits of ten to thirty-five miles per hour.

Messrs. Dennis and Begien, as well as the undersigned, were originally of the same opinion as Mr. Van Zandt, but were forced by the weight of the evidence to acknowledge that the resistance would be practically a constant within the ordinary limits of freight train speed on properly maintained track. Mr. D. E. Crawford called attention to this point several years ago, after extensive tests on the Pennsylvania Lines.

In the following statement some facts are shown as deduced from dynamometer tests analyzed personally by the writer. These particular tests were on a valley division of long tangents and long continuous stretches of exceedingly low gradient.

In analyzing tests on many other districts and platting the same graphically, a wide variation was noted in resistance for the same train for given velocities, but it appeared that a straight line representing uniform resistance would practically strike through the average of all these points, contrary to expectations.

The following tests were made particularly to determine the truth with reference to resistance at the higher velocities, and points were chosen to eliminate the question of acceleration and gradient as far as possible. The track was well ballasted to grade stakes within two years' prior to the test and had been maintained in good condition.

According to Prof. Schmidt's formula the draw bar pull on level grade test "B" could have been 9,004 lbs. at 30.5 M P H for this locomotive and on descending .0517% grade test "A" 8,384 lbs. at 35 M P H.

No fireman could put coal enough into the fire box of this locomotive to develop this power at the given speeds. This train was sent over the entire division, and the *average* of all points and velocities did not vary far from those given above after the journals had been warmed up, although individual points varied considerably from the average.

With such facts as these in the hands of a man who has been in practical work and study of these questions for a number of years, it is impossible to accept the view that the Schmidt tests should always be applied in making economic studies, but they can be used in considering economic value of good track maintenance.

Problems of Economics of Location must be based on the assumption that the type of materials used and the labor expended in maintenance have been such as to produce the most economical results.

Since the report to the American Railway Engineering Association, the Baltimore & Ohio has been to a large expense in making some extensive dynamometer tests and having the same analyzed by a specially organized force for the work. From these tests nothing has developed to show that the American Railway Engineering Association should reconsider its constant formula.

It would be well for the Engineering Fraternity to recognize that estimating of train resistance can never be reduced to an exact science. The variables are too complex to make this possible. It should be unnecessary to go into detail to explain why this is so, as pages have been written on the subject.

To those who know the men, it appears foolish to think that Mr. D. E. Crawford, general superintendent motive power, Penna. Lines West, Mr. A. C. Dennis or Mr. R. N. Begien would support a constant resistance formula for a given weight car where their original inclination was to believe otherwise, except that the mass of evidence conclusively proved the fact.

(Signed) A. K. SHURTLEFF.

Details of a Typical Test.

Locomotive.

Type 4-6-0.
Cylinders 19x24 in.
Drivers 69 in.
Boiler pressure, 180 lbs.
Heating surface 1,800 sq. ft.
Weight on drivers 131,200 lbs.
Total weight working order, including tender, 238,400 lbs.

	A	B	C
No, cars in train	34	34	39
Scale weight of train	1,354 tons	1,354 tons	1,584 tons
Average weight per car	39.8 tons	39.8 tons	40.6 tons
Distance maintained speed	4,625 feet	4,473 feet	4,700 feet
Time in passing distance	90 seconds	100 seconds	120 seconds
Velocity in passing distance	35 M P H	30.5 M P H	26.7 M P H
Uniform gradient	—.0517%	Level	—.034%
Recorded draw bar pull	5,000 lbs.	6,500 lbs.	6,500 lbs.
Recorded draw bar pull per ton of train	3.69 lbs.	4.80 lbs.	4.10 lbs.
"R" per ton corrected for level grade	4.72 lbs.	4.80 lbs.	4.78 lbs.
"R" as per Schmidt formula	7.23	6.65	6.21

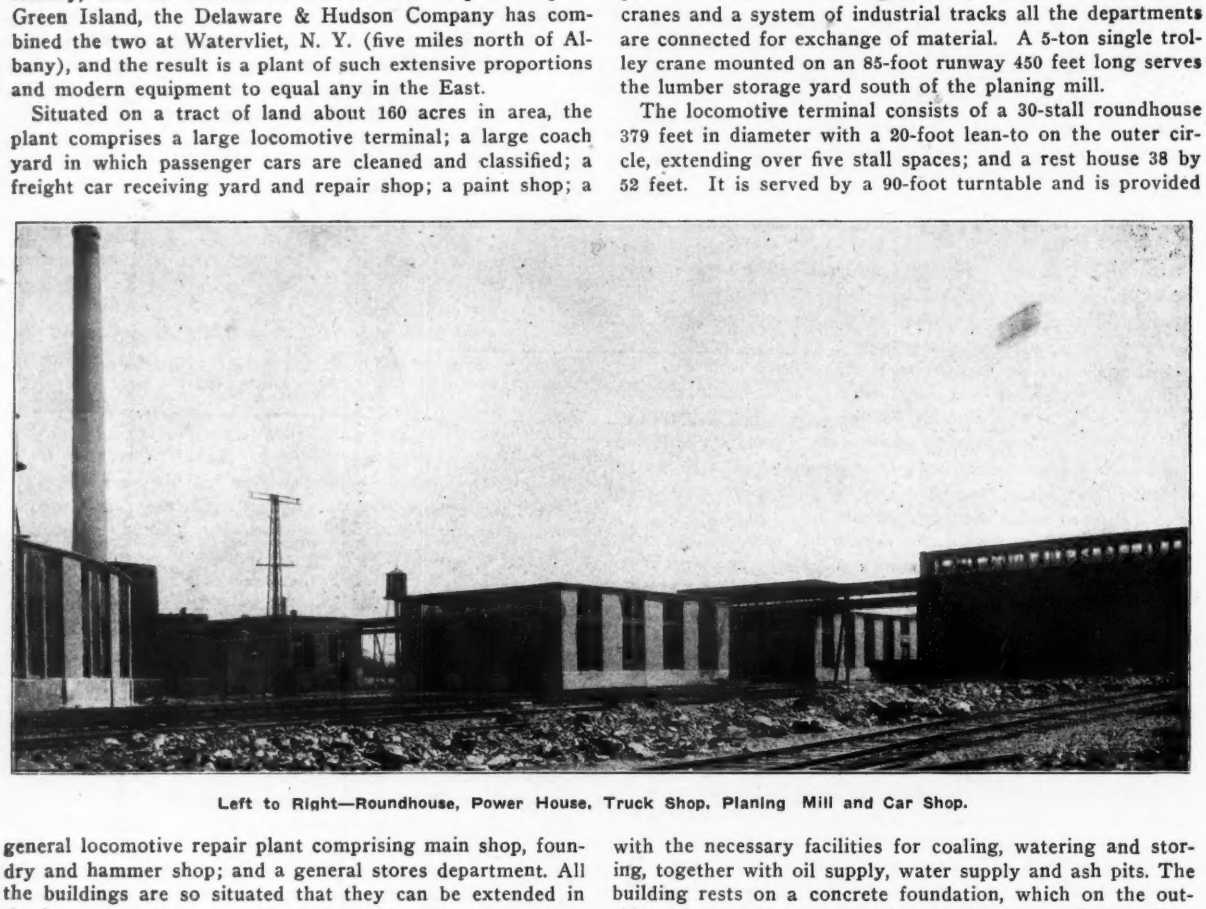
Watervliet Terminal, Delaware & Hudson Co.

By J. C. Chapple.

Having outgrown its coach yard facilities in the city of Albany, and its locomotive terminal and repair shop at Green Island, the Delaware & Hudson Company has combined the two at Watervliet, N. Y. (five miles north of Albany), and the result is a plant of such extensive proportions and modern equipment to equal any in the East.

Situated on a tract of land about 160 acres in area, the plant comprises a large locomotive terminal; a large coach yard in which passenger cars are cleaned and classified; a freight car receiving yard and repair shop; a paint shop; a shop and planing mill is a 67½-foot runway 1,200 feet long provided with a 5-ton single trolley crane. By these two cranes and a system of industrial tracks all the departments are connected for exchange of material. A 5-ton single trolley crane mounted on an 85-foot runway 450 feet long serves the lumber storage yard south of the planing mill.

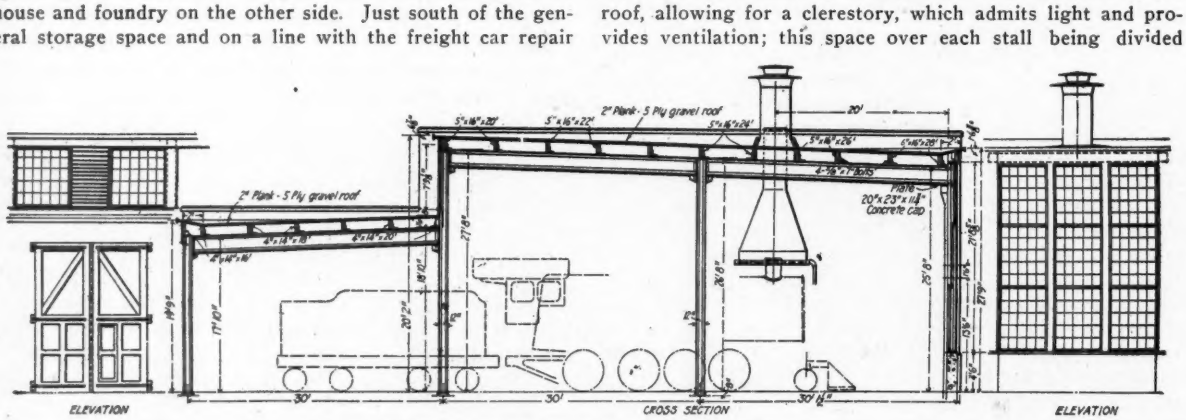
The locomotive terminal consists of a 30-stall roundhouse 379 feet in diameter with a 20-foot lean-to on the outer circle, extending over five stall spaces; and a rest house 38 by 52 feet. It is served by a 90-foot turntable and is provided



Left to Right—Roundhouse, Power House, Truck Shop, Planing Mill and Car Shop.

general locomotive repair plant comprising main shop, foundry and hammer shop; and a general stores department. All the buildings are so situated that they can be extended in the future to suit the growth of the road without interfering with each other in the least.

As seen from the layout the longer dimension of the yard and also of the shop buildings lies in a general north and south direction; the incoming and outgoing tracks for the various departments also lie in this direction. A 100-foot span crane-runway 968 feet long, on which is mounted a 10-ton single trolley crane, extends over a general storage space between the main shop on one side and the store house and foundry on the other side. Just south of the general storage space and on a line with the freight car repair with the necessary facilities for coaling, watering and storing, together with oil supply, water supply and ash pits. The building rests on a concrete foundation, which on the outside and end walls extends 4 feet 6 inches above the floor line, from which point windows 18 feet wide extend to the eaves, at which point steel lintels are used. Between the windows are 8½-foot brick pilasters, to the roof. The building is 90 feet between inner and outer walls. Two rows of steel columns spaced 30 feet on centers (and being the same distance from the outer wall), together with the steel door-posts in the inner wall, support the roof. The roof for the first 30 feet from the inner circle is 10 feet lower than the rest of the roof, allowing for a clerestory, which admits light and provides ventilation; this space over each stall being divided



Section Through Roundhouse, Watervliet Shops.

into a louver 4½ ft. by 6½ ft., and two windows 6½ ft. by 6½ ft. The inner circle is made up of hinged wooden doors without glass panels. The roof is a 5-ply gravel supported on wooden purlins. Asbestos smoke jacks are used, being spaced 20 ft. from the outer wall. A Nichols turntable tractor operates the turntable. A complete boiler washing system has been installed by the National Boiler Washing Co. of Chicago, the tanks and pumps being located in the power house. The lean-to or the roundhouse will be utilized for light running repairs and a tool room. The rest house contains a restaurant, sleeping room, rest room, wash and locker rooms for the convenience of trainmen. This building will also contain the offices of the roundhouse foreman, and engine dispatcher, together with the switchboard for the intercommunicating telephones for the entire shops. The round house together with the lean-to and rest house are heated by direct radiation.

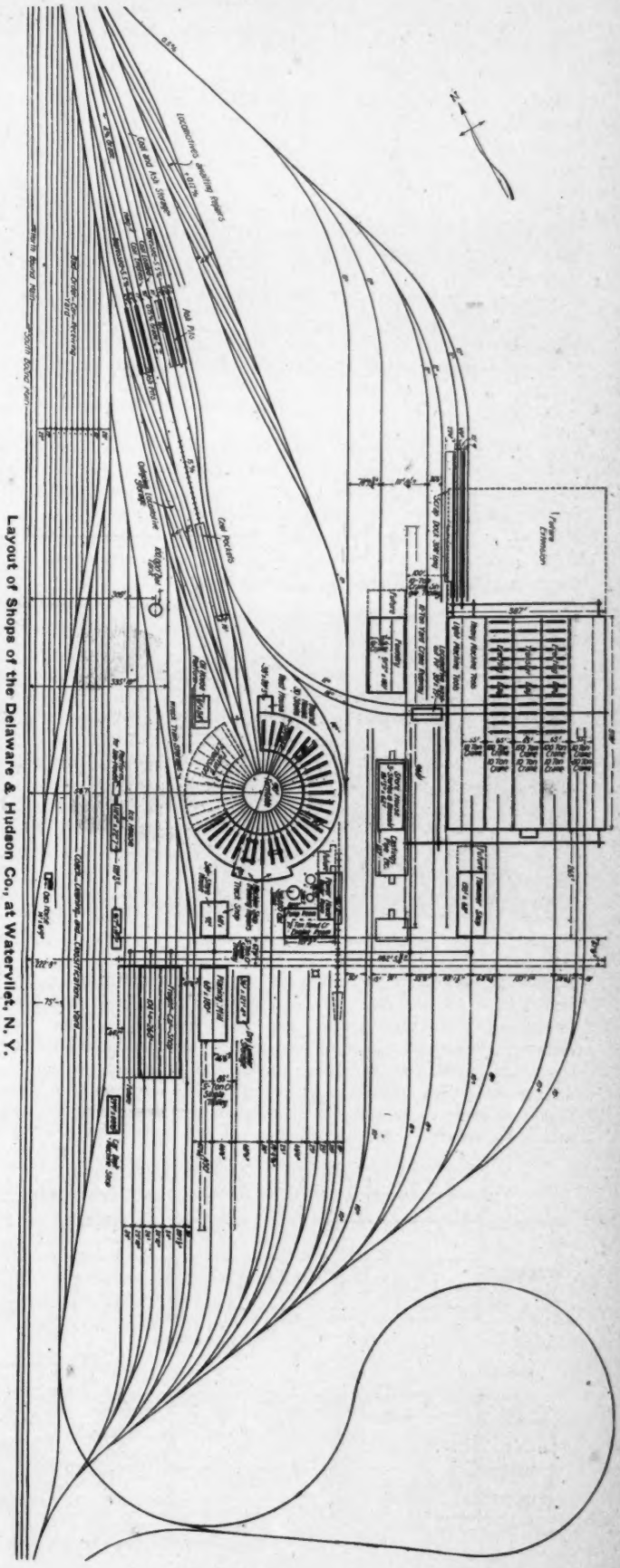
The incoming and outgoing tracks of the terminal are arranged to give the greatest possible advantage in handling locomotives to and from the roundhouse. There are four concrete ash pits each 160 feet long and arranged in pairs with a depressed ash track between the two pits of each pair. Between the two pairs of ash pits are the tracks for the coal pockets, one for the loaded cars and one for the empties. Cars are hauled up the incline to the pockets by means of an electric hoist. The pockets which have a capacity of 600 tons, are equipped with air operated automatic gravity measuring chutes of two and four ton capacity. The wet sand storage together with the sand drying and handling equipment is located at the end of the coal pockets, it being so arranged that locomotives can take sand and water simultaneously. A 100,000 gallon storage tank provides water for the locomotives. All of the incoming and outgoing tracks converge into three main tracks before entering the roundhouse. Between two of these tracks is a grill storage for outgoing locomotives each track accommodating two locomotives. This permits any engine to be handled without moving the others. There is also a storage for ash cars near the ash pits. The locomotive terminal is provided with an oil house 34 ft. by 60 ft. with basement. This oil house, having a capacity of over 45,000 gallons will also serve the entire plant, provisions having been made by large tanks to take care of the fuel oil which is pumped underground to the various departments. The pumps are the latest Gilbert & Barker model T-6 self measuring pumps and are equipped with gallon meters which record the total amount of oil drawn through each pump for a given period.

Coach Terminal.

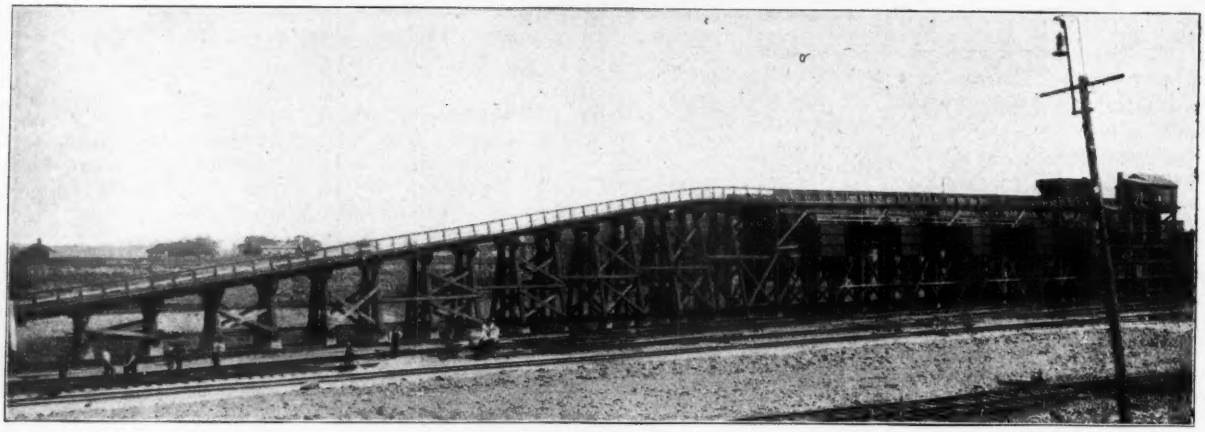
The very heavy travel on the Delaware & Hudson lines caused by the many cities and places of interest and recreation being on said lines, calls for a large and fully equipped coach cleaning and classification yard. This is provided by a coach yard with over two miles of track. This yard is piped to all points, by means of underground pipe tunnels, with air, hot and cold water, steam, filtered drinking water, Pintsch gas, and a complete vacuum cleaning system, the equipment for same being located in the coach yard stores and office building which is 20 ft. by 96 ft. and located centrally with respect to the yard. An ice house 22 ft. by 111 ft. is located just north of the coach yard office and stores building, while directly across the yard isolated from all other structures is the gas plant. As a time saving device a complete loop has been formed in the south end of the plant, on which a complete train can be turned.

Freight Car Department.

This department consists of a freight car repair shop, a planing mill, a truck shop, repair tracks and a "bad order" storage yard. The freight car repair shop is 104 ft. by 268 ft. and is divided into two bays, each bay being served by a 15-ton crane. Two tracks together with an industrial track



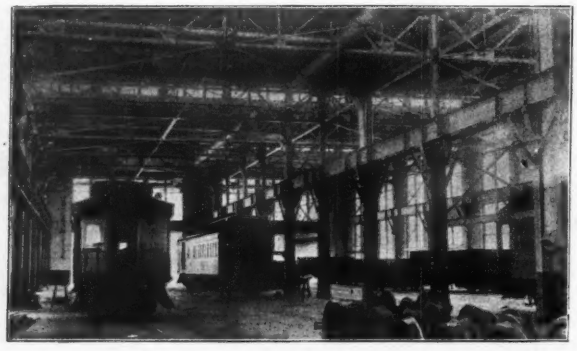
Layout of Shops of the Delaware & Hudson Co., at Watervliet, N. Y.



Coaling Station and Trestle, Watervliet Shops.

enter each bay. For future extension of this building it is so constructed that another bay together with its accompanying crane and trucks can be added. There has also been provided for this department a small machine and blacksmith shop 22 ft. by 88 ft. in which light work will be done.

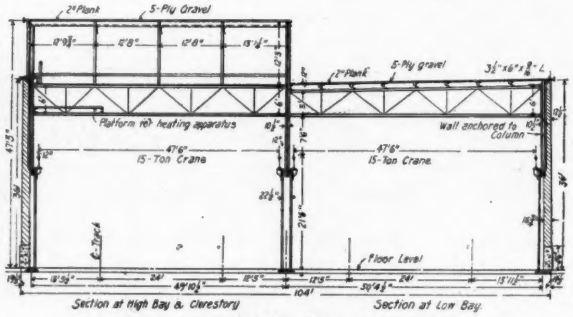
The planing mill is a building 68 ft. by 180 ft., having a track extending longitudinally its entire length. The lumber storage is located to the south of the planing mill and is served by a 5-ton crane. The dry lumber storage is located to the east of the planing mill. Just across the 67½ ft. crane runway and directly north of the planing mill is the truck shop. In connection with the truck shop is a sub-stores department. This relieves the general storeroom and also makes it more convenient for the freight car department to secure its material. All the buildings of this department are tied together with a standard gauge industrial track. The freight car repair tracks, of which there are seven, extend both north and south from the freight car repair shop. In the north end of the plant is provided a "bad order" car receiving yard with a capacity of more than 300 cars.



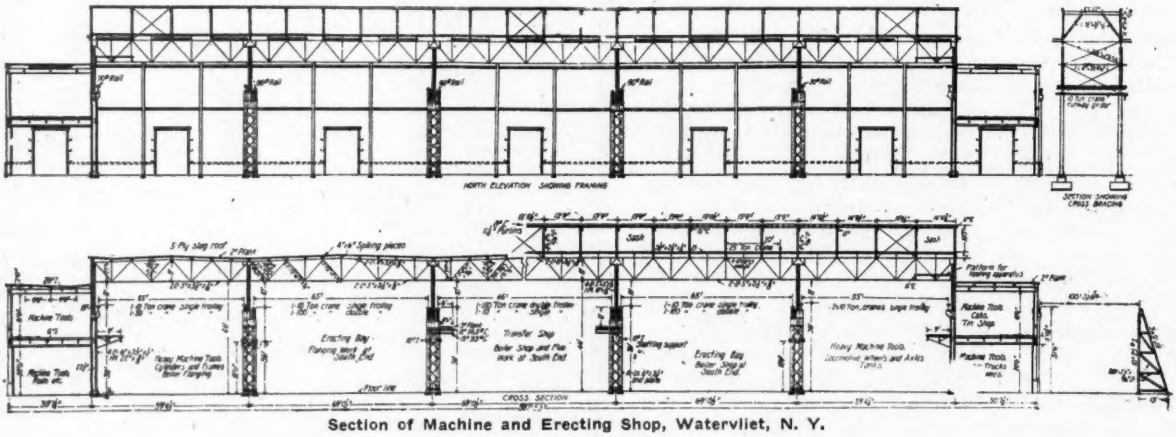
Interior of Freight Car Shop.

Locomotive Repair Shop.

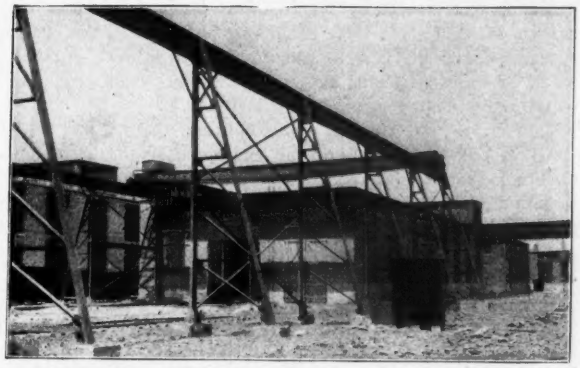
With the exception of the hammer shop and foundry, all departments of the locomotive repair plant are under one roof in a building 510 ft. long by 387 ft. wide on the east side of the plant. This building consists of seven bays—the center bay and adjoining bays on each side of it are 69 ft. wide, the side bays 59 ft. in width, while the outside bays, which consist of a ground floor and gallery, are 30 ft. wide. The incoming track enters the west side about the middle of the building. On this track just outside of the entrance is a locomotive which may be covered with grease, dirt, etc., are given a thorough washing with hot water under pressure.



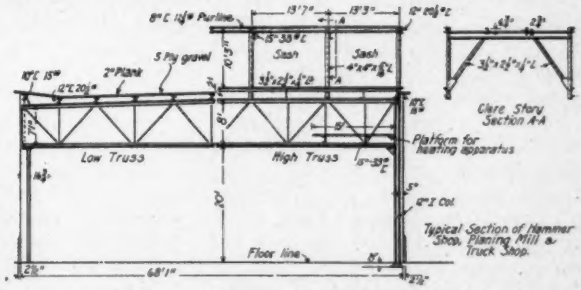
Section of Freight Car Shop at Watervliet.



Section of Machine and Erecting Shop, Watervliet, N. Y.



Showing End of Planing Mill and Craneway.


Low Truss
High Truss
Platform for heating apparatus
Floor line
Typical Section of Hammer Shop, Planing Mill & Truck Shop.
Clere Story Section A-A

Section of Hammer Shop at Watervliet.

By this means most of the grease and dirt can be removed much cheaper and in a more satisfactory manner than with the lye vats and it also makes the work of stripping much cleanlier.

The system of handling locomotives in this shop differs from the ordinary system in that a 150-ton overhead crane takes the place of the usual transfer table and pit, the space usually reserved for the table and pit being utilized for sorting material, etc. The engines are handled from the incoming track to the pit, upon which the stripping is to be done, by the 150-ton transfer crane. After being stripped the engines are placed on special trucks opposite the pit in either of the erecting bays in which the work is to be done. They are then dragged into the erecting bay by means of an electric drag which is moved from track to track as required by the cranes in the erecting bays. The erecting bays each have 13 pits. The transfer bay is provided with seven pits—one each on the incoming and outgoing tracks, the others on alternate tracks. The boilers requiring heavy repairs are carried directly to the boiler shop by the transfer crane. The various parts requiring repairs are distributed from the pit upon which the engine is stripped to the several departments assigned to the different work, while those not requiring repairs are stored in the transfer bay until needed for erecting. Each of the erecting bays is provided with a 100-ton 65 ft. span crane. In the south end under the east gallery is the small work smith shop, the remainder of the south end being utilized as a boiler and tank shop—each bay being served by a 10-ton crane. The north end and central portion of the two 59 ft. bays are used for heavy machine work, these bays being served by 10-ton and 30-ton cranes. In the bays containing the galleries the light machine work is done both on the ground floor and gallery. The ground floor department handles the rods, pistons, valves, etc., while the galleries accommodate the manufacturing tool room, brass room, electric repair room, paint shop, cab shop, tin shop, etc. The galleries are served by the cranes in the machine bays by means of platforms projecting 9 ft. from the galleries at suitable intervals.

Foundry.

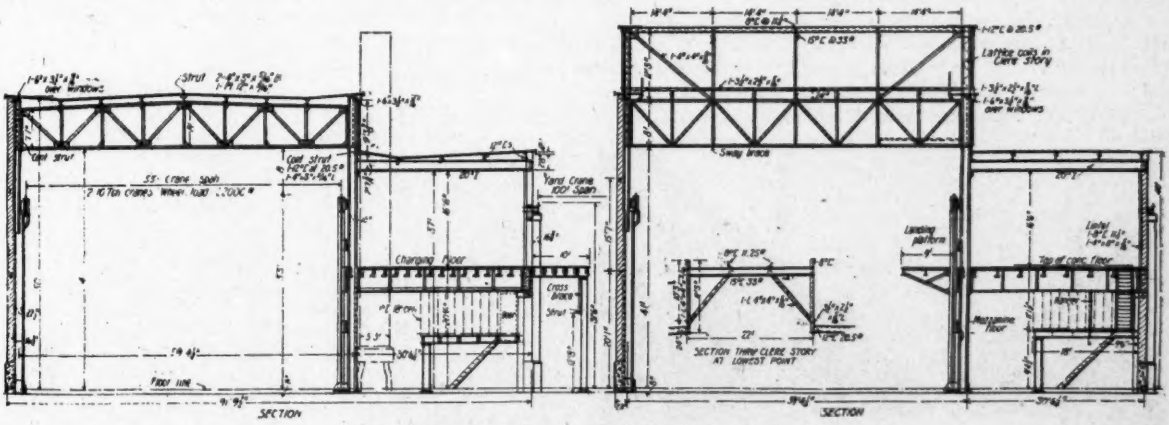
The foundry is 91 by 180 ft., and is located west of the main shop and separated from it by the 100 ft. span crane runway. The building consists of a main bay 60 ft. wide, served by a 10-ton crane which will be utilized for the cast iron and cast steel moulding floors, and a 30 ft. lean-to consisting of ground floor and gallery. In the gallery are the charging floors and brass foundry, while the ground floor beneath the gallery is utilized for the core ovens, tumblers, etc. The blowers together with the wash rooms, are located on a mezzanine floor between the gallery and ground floor. The gallery is served by an elevator from the ground floor, and also by both the foundry crane and the general storage crane by means of the overhanging platforms. The capacity of the iron foundry is 20-tons per day, and of the steel foundry 2-tons per hour. The cleaning room is provided with a dust exhaust system. This building is connected with the main shop by means of industrial tracks. Immediately north of the foundry is a two story building 53 ft. by 82 ft. which will be used for a pattern shop and pattern storage.

Hammer Shop.

The hammer shop is located south of the main shop and on a line with the 67½ ft. crane runway. This building is 68 ft. by 158 ft. and will be utilized for the heavy forging work. Extending through its entire length and into the main shop is a standard gauge track, which greatly facilitates the handling of the heavy material.

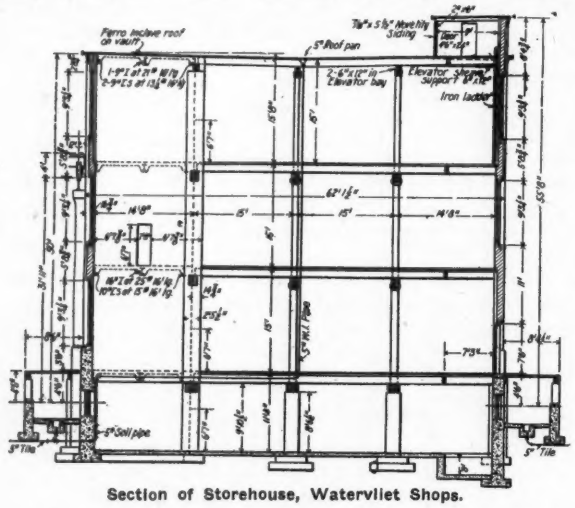
The Power Plant.

The power house is located on a line with the 67½ ft. crane runway just south of the roundhouse. It is an "L" shaped building 156 ft. by 121 ft. with boiler room 41 ft. wide and an engine and pump room 80 ft. wide. This plant is



Sections Through Foundry Building, Watervliet Shops.

practically auxiliary as the power is furnished from the Mechanicville power station of the Delaware & Hudson Co., 20 miles north of the shops. The power will be delivered at 11,000 volts, 40 cycles and transformed to 240 volts A. C., a motor generator set also being provided to convert this power into D. C., at 240 volts. The plant is also provided with a 350 K. W. D. C. reciprocating steam unit, the engine for same being furnished by the C. & G. Cooper Co., and the generator by the General Electric Co. The plant is also equipped with a generous compressed air-supply system consisting of a 2,000 ft. per minute steam air compressor, and a 2,000 ft. per minute motor driven air compressor, both of these machines being furnished by the Ingersoll-Rand Company. The steam power is generated by six 400 H. P. Babcock & Wilcox boilers in batteries of 800 H. P. each. The fuel will be birdseye coal and



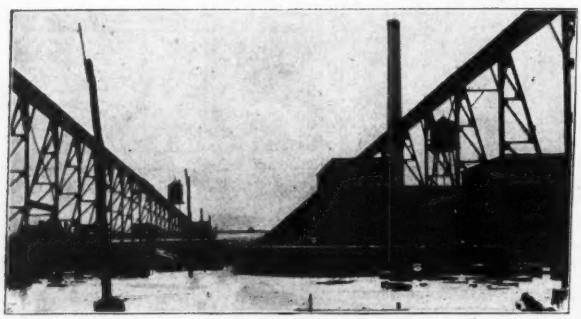
Section of Storehouse, Watervliet Shops.

will be burned under forced drafts furnished by two 8 ft. fans furnished by the Green Fuel Economizer Co. The stack is of concrete, 9 feet in diameter, 210 feet high, and was built by the General Concrete Construction Company. The ashes are handled by means of an air operated hoist.

In the pump room are located the feed water heater, boiler feed pump, fire pump, hydraulic pump, and the boiler washing equipment.

Stores Department.

The storehouse is located centrally with respect to the roundhouse and main shop, and on a line with the 100 ft. crane runway. This building is of mill construction and is 62 ft. by 162 ft. It consists of three stories and basement and will serve the entire northern division as mechanical storehouse and the entire system as stationary storehouse. The offices of shop superintendent, master mechanic and efficiency engineer, together with the stores department office, will be located in this building. Materials will be handled from floor to floor by means of a 3,000 lbs. capacity elevator. On the north, east and west sides of this building is an 8 ft. platform to facilitate in loading and unloading material, while on the south end is a casting platform 78 by 142 ft. This platform together with that on the east side of the storehouse is served by the general storage yard crane. Tracks run parallel and in close proximity to all of these platforms and the storehouse is also connected to the main shop with an industrial track.



Main Craneway, Watervliet Shops.

Heating and Lighting.

All of the buildings with the exception of the storehouse, the truck shop and the roundhouse, which are heated by direct radiation, are heated by indirect radiation—the heating coils and motor driven fans being located in the roof trusses in the clerestory bays. The shop and yard lighting is accomplished by means of some 200 "Stave" 100 hour flaming arc lamps.

Water Supply and Storage.

Water is supplied to the plant from a concrete lined well 50 ft. deep and 60 ft. in diameter. Two 1,000 gallon per minute centrifugal pumps are used, being operated by 50 H. P. motors. The water is pumped through a 10 inch main to a 60,000 gallon per hour capacity water softener from which it passes into a 318,000 gallon storage tank built by the Des Moines Bridge & Iron Company and a 100,000 gallon elevated tank. Approximately 200,000 gallons of water are available at all times for fire protection for which purpose fire pumps have been installed. The tank for fire service is located back of the power house on a 90 ft. tower and has a capacity of 50,000 gallons. The round house and the hammer shop are equipped with the "dry" sprinkler system of fire protection while all the rest of the buildings are fitted with the "wet" sprinkler system. The water obtained from the well will be filtered for drinking purposes, the New York Jewell-Filteration System being installed in the power house and the supply being pumped from the filter to a 10,000 gallon tank south of the power house and separated from it by the 67½ ft. crane runway.

As will be seen from the accompanying illustrations the construction of the buildings of this plant is such as to permit a great degree of economy and yet provides complete housing to all parts. The placing of the entire locomotive department under one roof offers a great many advantages, chief among which is the fact that supervision is greatly facilitated; also the movement of material, practically all of which is done by cranes, is facilitated and there is an economy in heating, due to infrequent opening of doors and a minimum exterior wall area.

This plant was designed and constructed under the immediate supervision of V. Z. Caracristi, Consulting Engineer of the Delaware & Hudson Co.

The Cleveland, Cincinnati, Chicago & St. Louis is reported to have awarded a contract for the one-story machine shop that will be erected at Harrisburg, Ill. This company will also build a new brick pumping station on South Center street in Bloomington, Ill.

The Gallatin Valley, it is reported, will make several improvements to its property at Bozeman, Mont., including the erection of a roundhouse.

THE ELECTRIFICATION of Prussian railroads has, according to the Mechanical World, met with such successful results on an experimental section between Dessau and Bitterfeld, which are situated about 75 miles south-west of Berlin, that it has been decided to extend the electrification of that trunk line to Leipzig, about 20 miles south of Bitterfeld, and to Magdeberg, about 50 miles north of Dessau. From Leipzig the electrification will also run north-west to Halle, about 20 miles, and thence again to Bitterfeld, forming a triangle at that end of the system. Another line will be electrified between Lauban and Konigszelt, which are situated about 150 miles east of Leipzig. In all there will be about 192 miles of road on which electric traction will be installed, using electric locomotives. The enlargement of the Muldenstein power plant in the Bitterfeld lignite district has been commenced, as this station is to supply high-tension alternating current for the whole system.

NORTHUMBERLAND YARD, NORTHERN CENTRAL RY.

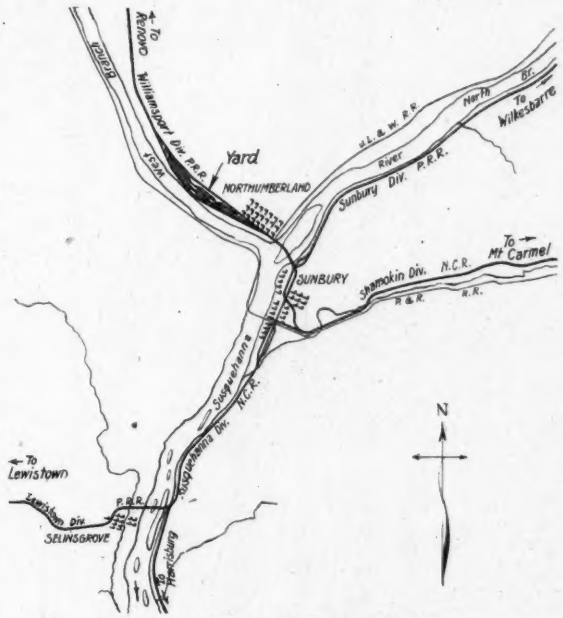
The Northumberland yard, now practically completed, is located practically at the junction of the Williamsport and Sunbury divisions of the Pennsylvania R. R. and the Susquehanna and Shamokin divisions of the Northern Central Ry. The Lewistown division of the Pennsylvania R. R. reaches the yard over the tracks of the Susquehanna division, Northern Central Ry.

There is also a connection at Northumberland with the D. L. & W. R. R., with tracks for interchange of freight between the two roads, this interchange being, however, outside the limits of the yard proper.

The yard classifies and takes care of the entire freight movement to and from the above divisions, except that solid anthracite coal trains for the East from the Sunbury or Shamokin divisions are not taken into the yard, but move direct via Sunbury.

The average number of trains passing through the yard, in and out, at the present time is 75 and the average daily car movement is about 3,200. There is standing room in the yard now for about 4,000 cars and provision has been made for enlargement to 6,000 cars. The yard is approximately three and one-fourth miles long by 1,500 feet in width at the widest point.

The dotted lines in the plan represent tracks left for future



General Location of Northumberland Yard.

construction and the capacities of the receiving, classifying, repair tracks, etc., are indicated on the plan.

There are no team delivery tracks in the yard, they being located at the freight house proper in the town, where the local business is taken care of.

The freight house is 30 ft. x 112 ft. 8 in. on the first floor, consisting of a freight room 30 ft. x 88 ft., the remaining space being used for cashier's office, warehousemen's room, toilets, stairway, etc. The second floor, 30 ft. x 64 ft. 8 in. in size, contains the main office, record and supply room, and the agent's private office.

The building is of timber construction on concrete foundations, the siding being ⅞-inch lumber covered with asbestos shingles and having a slag roof. The sides of freight room can be entirely opened, having vertical sliding doors between columns, spaced 16 feet apart. There is a platform 8 feet wide on the track side of the house.

In the yard there is a transfer station consisting of a main shed 30 feet in width and three parallel sheds, each 16 feet in width, all 570 feet long, with the necessary tracks for operating them.

Particular attention is called to one feature in this installation. There will be observed in the layout of tracks west of the buildings, intermediate tracks lying between and connected with the tracks alongside of the sheds; the purpose of these intermediate tracks is to place thereon, as they arrive, the cars for the transfer. They can then be pushed alongside of the platform as soon as the completed cars are pulled away, which results in a minimum loss of time for the freight handlers.

About 600 tons of freight are handled through the transfer daily, on a tonnage basis. There is no power equipment for handling freight at either the transfer shed or the local freight house.

There are two track scales in the yard, but neither of them is located on the humps, for the reason that the percentage of cars to be weighed is very small and weighing can better be done at the location shown on the plan.

The yard is operated by the hump method of switching, the cars being pushed over the summit and taken into the classification tracks by "car riders" or brakemen.

The switches into the classification tracks are operated electro-pneumatically by a man manipulating a push button machine in the second story of the tower located at the hump. He is furnished a list, giving the car number and the number of track to which it is to be sent for each train as it approaches the hump, and thus is prepared to quickly set up a route for each approaching car or cut.

Another feature designed for use in this yard is the "station order sifter"; the purpose being to classify local freight cars for a particular division to one track, and then to classify in station order by pushing through the sifter.

A further use of it has been made in reducing the number of classification tracks and thereby decreasing the width of the yard in the following manner. It frequently happens where a large number of classifications are made that there will be five or six that will not average more than 5 or 6 cars each. These can all be classified to one track connecting to this sifter or gridiron and later separated into the proper classification by that means.

Another feature peculiar to this yard was the location of the engine facilities outside of, rather than between the east and west bound yards and the manner of reaching same with arriving engines.

It will be noticed that all engines (whether from the east or west) reach the ash pits, coaling wharf, engine storage tracks, etc., headed east. As about 65 per cent of the power is used for east bound trains, and because of pooling the power it is often impossible to say what direction the arriving engine will next take, this arrangement gives a minimum of turning engines. As the west bound engines can back around the large circle under the east bound hump to reach their trains properly, it is not necessary to have an additional turntable outside of the engine house.

Grading.

The excavation, amounting to about three million cubic yards, was slightly in excess of the embankment required for the present track layout, and was wasted where future extensions would be made.

The alignment of the railroad before the yard construction traversed approximately the center of yard layout longitudinally, with high ground to the north and low ground on the south side.

The grading was done by using the high ground to fill the low. The side hill cut reached as much as 95 feet in depth and the fill at the east bound hump was approximately 40 feet in depth.

There were as many as seven steam shovels working at one time and the earth was moved in trains of side dump cars, using both narrow gage and standard locomotives and equip-

ment. An embankment for two main or running tracks was made on the alignment of the present eastbound main, to which both running tracks were transferred and all traffic operated thereon, leaving the entire yard area free for grading operation without interference from, or with the regular train movements. A portion of the material in excavation was shale and required drilling and blowing to break up for shovels.

A 12-ft. span concrete arch culvert, about 1,200 feet long extends across the yard in the vicinity of the engine house, and in addition there are six small concrete culverts, about 4 feet in diameter, extending across the yard.

The work was commenced in July, 1909, and the yard was put partially in service August, 1911.

Track.

Eighty-five pound rail was used in the tracks, with the regular Pennsylvania R. R. standard switches, frogs, low switch stands, etc.

The body tracks of the various yards are spaced 13 feet centers, which permits the use of No. 7 ladders with No. 8 turnouts.

Parallel ladder tracks are spaced on 15-ft. centers.

Lighting.

Distributed throughout the yard are 137 General Electric luminous arc lamps of 800 candlepower each and in the engine house there are installed 37 of the same kind of lamps. The lamps are operated in series, there being 8 circuits, controlled from the power house, with 20 to 25 lamps on a circuit.

The following groups of lamps are controlled independently of each other:

East end of yard.
West end of yard.
West bound classification yard.
East bound classification yard.
Engine house (2 circuits).
Engine house yard.
Car repair yard.

The location of the lamps in the classification yards are shown by circles on the plan. A 20-foot spacing between centers of tracks is made at certain intervals in the classifying yards, which permits the erection of a pole line therein for lighting purposes. The east bound yard (30 tracks wide) has 5 rows of lamps, 3 intermediate and one on each side outside of tracks; the west bound yard (20 tracks wide) has one intermediate and 2 outside rows. The lamps are installed on harps mounted on the tops of 35-foot poles, which places the arcs 30 feet above the ground.

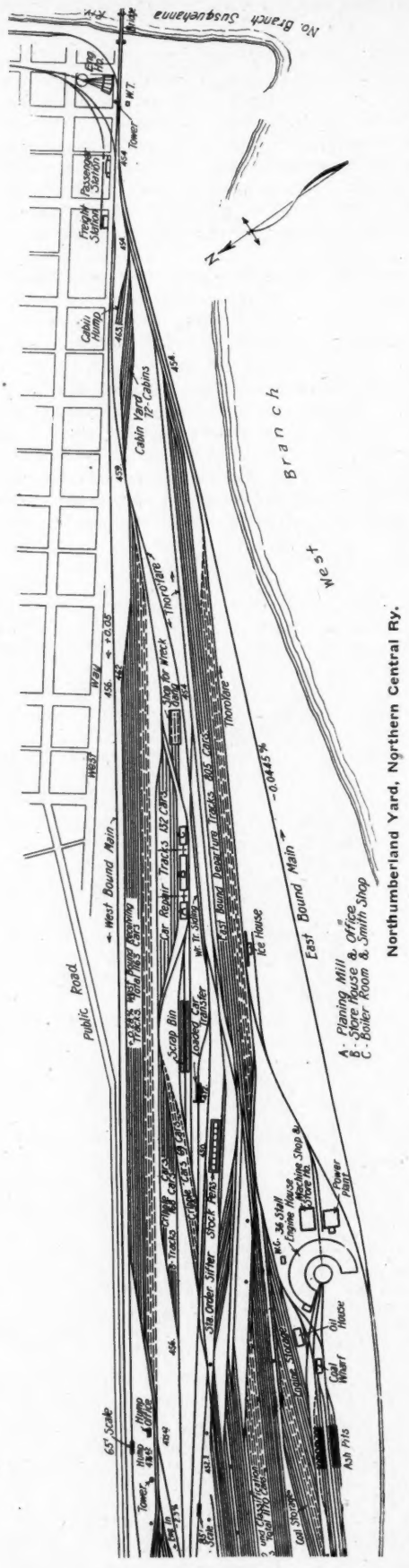
The lamps are spaced approximately 200 feet apart, being somewhat closer together near the hump and further apart through the rest of the yard. Metal deflectors are used on all the lights near the hump to direct the light away from the tower operator's eyes.

The interior lighting of the power plant and machine shop is by Cooper-Hewitt mercury vapor lamps. In all other buildings except the engine house Tungsten incandescent lamps are used.

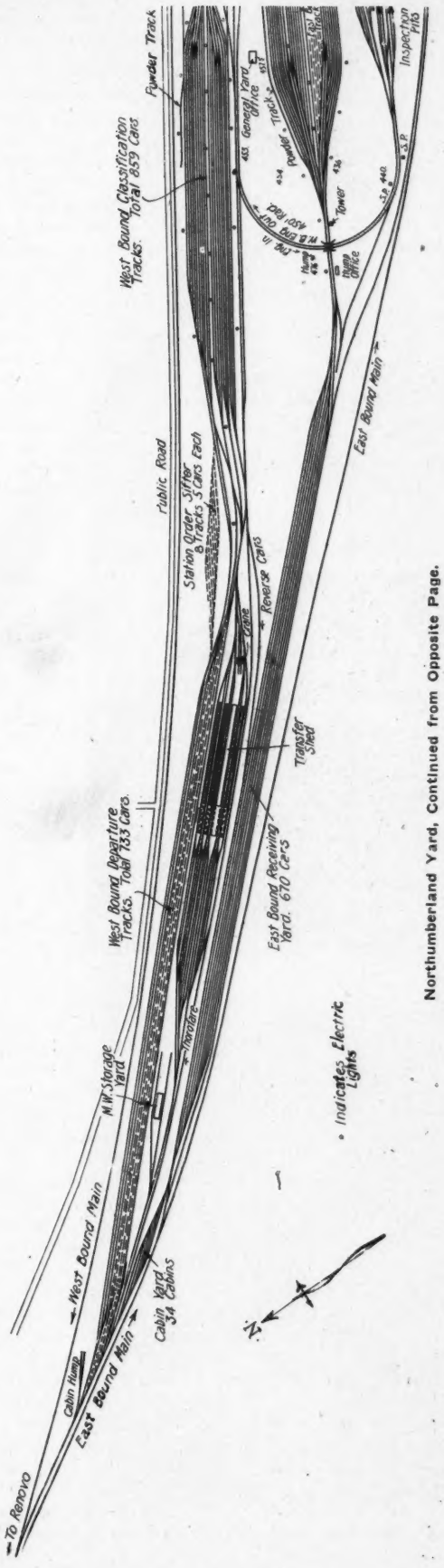
Current for the building lighting is distributed about the yard at 2,200 volts and stepped down through transformers for use at each set of buildings. Current for motors and lights at the car repair shops is supplied over a 3-phase, 2,200-volt transmission line and transformed to 220-volt, 2-phase current in a fireproof concrete transformer house.

All electric current for use throughout the yard is generated at the yard power plant.

The force employed at the rpesent time, including the men in the master mechanic's layout as well as the yard operation and transfer, consists of about 950 men. The plan for the yard was prepared in the office of J. H. Nichol, principal assistant engineer, as were also the floor plans of the various



Northumberland Yard, Northern Central Ry.



Northumberland Yard, Continued from Opposite Page.

buildings. The construction plans for the buildings were prepared by the architect in the office of Mr. A. C. Shand, chief engineer, Pennsylvania R. R.

All the work of both yard and building construction was done by contract under the direction of the chief engineer and his subordinates. We are indebted to Mr. J. H. Nichol, principal assistant engineer, for the information and plans contained in this article.

The Albany Passenger Term. Co. is said to have awarded a contract to A. M. Walkup, Richmond, Va., for the erection of the new railway station in Albany, Ga. The estimated cost is $60,000.

The Atchison, Topeka & Santa Fe, it is reported, will make several improvements at La Junta, Col., among which will be a brick general office building. The cost is said to be $150,000.

The Atlantic Coast line, it is said, has awarded the contract to D. D. Rose, of Rocky Mount N. C., for the construction of a freight warehouse at Norfolk, Va., 800x80 ft. in area, and a transfer shed 500 ft. long. The contract for the piling has been awarded to E. Cross & Sons, of Norfolk, Va.

The Central of Georgia, it is reported, will build a repair shop and roundhouse at Eufaula, Ala.

Officials of the Chicago, Burlington & Quincy have taken up with the D. M. Swain Co., Peoria, Ill., the matter of installing a draw in the fixed bridge over the Illinois River at La Salle, Ill.

The Chesapeake & Ohio, it is said, will make expenditures and improvements on its shops at Russell, Ky. The roundhouse will be enlarged and a total of $1,000,000 will eventually be spent.

The Chesapeake Western, it is said will erect a station at Harrisonburg, Va., at an estimated cost of $20,000.

The Chicago & Alton is said to be about to award the contract for its new station at Bloomington, Ill. The plans have been completed and show a very complete structure, the cost being $100,000.

The Chicago, Milwaukee & St. Paul, it is reported, will erect a two-story brick freight house at Faribault, Minn.

The Grand Trunk Pacific, it is stated, will soon erect a new hotel in Regina, Sask., at a cost of about $1,000,000.

The Greenville, Spartanburg & Anderson has ordered 1,425 tons of bridge material from the Virginia Bridge & Iron Works.

The Gulf, Colorado & Santa Fe is said to have asked for bids for the union depot and general office building that the road will erect at Galveston, Tex. Approximate cost, $500,000.

The Kansas City Southern is said to be considering plans for the erection of a depot at Texarkana, Ark., at an estimated cost of $100,000.

The Louisville & Nashville bridge at Bay St. Louis, Miss., is said to have been damaged, ten spans being totally destroyed.

The Missouri Pacific, it is reported, is preparing plans for a viaduct that it will construct over its tracks at Choteau and Vandeventer avenues in St. Louis, Mo.

The Missouri Pacific has announced plans for improvements at its central branch shops at Atchinson, Kan., to cost approximately $35,000. They include a new twelve-stall roundhouse, blacksmith shop, boilerhouse, oilhouse, additional track facilities and other minor improvements.

The New York, New Haven & Hartford, it is reported, has purchased a site in Parkville, near Hartford, Conn., on which a sub-freight house will be erected.

The Northern Pacific is reported to be considering the erection of a freight and passenger station at Coeur d' Alene, Ida., at a cost of approximately $40,000.

BRIDGING OF THE GAMTOOS RIVER.*

The Gamtoos River is crossed by a narrow gauge railway at the 51 mile post west of Port Elizabeth. The river at the crossing is tidal and is some 600 feet wide between its banks, which it overflows during heavy floods. The highest flood of recent years was that of the 11th of September, 1905, when there was 45 feet of water in the river, its normal depth being 15 feet. The Gamtoos is one of the big rivers of the Cape Province, and has been aptly named if the following derivation is correct:—Gamtoos is said to be of Hottentot origin, meaning "the lion's path." It has its source in the Sneeuwbergen Mountains near Richmond and takes in its course many large rivers draining an enormous area of mountainous country, and although little to be feared in its normal state, it is not to be trifled with during floods—and these flood periods have been very frequent of recent years.

In October, 1904, during the construction of the railway, and shortly after the erection of a temporary timber trestle, the river came down in heavy flood, overtopping the bridge by two or three feet and making a breach in it 90 feet wide. This flood, however, was eclipsed by the one already mentioned in September of the following year (1905), when water rose 10 feet above the rail level of the bridge, or 30 feet above its normal level, with disastrous consequences to the bridge and causing the railway traffic to be again interrupted. As every flood leaves a defined mark behind it in the shape of a deposit of soil, the banks accordingly bear witness to the fact that there have been many such floods in bygone ages. But while the floods of past generations are forgotten, the flood of 1905 is doubtless still fresh in the memories of those whose lives were then in danger, and of the many farmers who suffered loss of live stock and crops.

Gamtoos Bridge.

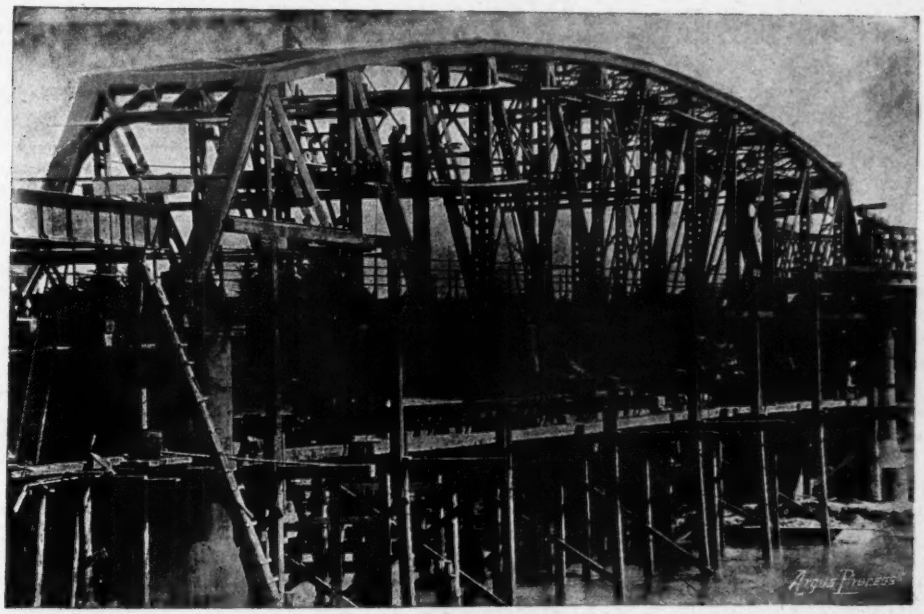
It became evident after the experience of two disastrous floods occurring in succeeding years, that the construction of a permanent railway bridge could not much longer be delayed. Designs and estimates were accordingly got out for a high level bridge and as soon thereafter as the finances would allow the work was started.

The foundations consisted of deposits of silt brought down by the river. These deposits had accumulated to an enormous extent—the work of countless ages—and the result of borings taken showed no solid foundation except at a prohibitive depth, only doubtful conglomerate and shale being struck 90 feet below the high water mark.

Before deciding upon the type of foundations to adopt, it was necessary to ascertain what this soft ground would carry. A test pile was accordingly put down a depth of 50 feet and thereafter weighted with rails to determine the load it would safely carry. The piers of the side spans are carried on timber piles. While the piers for the 40 feet side spans were carried on timber piles driven down into the river silt, the main piers which carried the central span, having more weight to carry (about 1,000 tons coming on each pier base) were founded on cast iron screw piles of 15 inches diameter, taken down to the sand beds underlying the silt. These screw piles resembled pipes with flange joints and were made in 10 ft. lengths bolted together. The bottom length had a screw blade 4 ft. 6 in. diameter cast as a separate piece and bolted on to the bottom length together with a point piece, thereby sealing up the end to prevent the silt getting inside the piles, which were afterwards filled with concrete. The piles were screwed down by means of a steam winch and endless wire rope passed around the rim of a capstan wheel 20 ft. in diameter. The capstan head was fitted on to a "dummy" pile which was bolted to the pile to be screwed down. Twenty-four such piles, varying from 50 ft. to 70 ft. long, composed the foundation for each main pier. As the work proceeded a goodly number of these piles were tested with a load of 80 tons of rails placed on the head of each pile, which is in reality double the working load they will ever be called upon to carry. When settlement took place under the test load, the pile was weighted with old ships' cable filled inside the pile and screwed down until it refused to go further. Some of the timber piles carrying the side piers were also subjected to a like test load.

The piles were put down with their heads at low water mark. The side piers were built in concrete, and in order to reduce the weight on the soft foundations, they were built hollow and were reinforced with old rails. The two main piers which carry the central span consist of cast iron cylinders resting on a grillage composed of heavy iron beams in two tiers, each tier laid transversely with the other and resting on the heads of the group of 24 cast iron piles. As the heads of these piles were not brought up above low water mark, it was necessary to build a cofferdam consisting of interlocking steel sheet piling in 20 ft. lengths driven

*From the South African Railway Magazine.



Main Span Gamtoos Bridge, Showing False Work.

in 12 in. widths. The cofferdam was kept free of water by the aid of hand pumps.

The erection of the girders of the side spans was an easy matter as each girder could be lifted intact by means of sheer legs and heavy block and tackle, and placed in position.

The erection of the main span, however, was a much more difficult matter. Various schemes were considered, the one finally decided upon being to erect the span on timber falsework at the level of the present bridge and then lift the whole span vertically a height of some 16 feet on to its final bearing on the tops of the cylinder piers, and at the same time to build up the cylinders underneath as the lifting proceeded. As this was known to be no small undertaking, and would take some time, it was originally planned to begin the work so as to ensure its completion before flood season was due. Owing, however, to the non-arrival of part of the iron-work and erecting plant by that date, considerable delay took place in starting the erection, and the margin of time left for completion before the floods were due was thereby greatly curtailed. Having all the falsework already built across the river and everything in readiness, there was no choice left but to proceed with the work and the erection was accordingly pushed forward, and the bridge was completed and lifted in position 3½ months from the date of the laying down of the first plate

Gamtoos Bridge, and View of Surrounding Country.

on the falsework. Fortunately, no heavy floods took place in the interval, but as the work was completed only two days before the anniversary of the flood of the 29th of September, 1904, and 16 days later than the great flood of 1905, there was some cause for anxiety, which will be better understood and appreciated by giving a short description of the work of rection.

The first work connected with the erection consisted in building a temporary staging or falsework of timber piles about 50 ft. long. The top of the falsework was kept at the same level as the old timber bridge for the purpose of getting a siding laid in from the main line for the convenience of bringing in material onto the staging. Upon this falsework, and supported by it, the steelwork of the main span was then erected and bolted up intact until it was made self-supporting. The heaviest pieces of steelwork to be handled weighed three tons, and these were picked up from the trucks by means of sheer legs and placed in their respective positions in the bridge and bolted up. The power obtained was from a steam winch stationed on the bank, a steel wire rope being led therefrom to heavy block and tackle rigged on the sheer legs. A gantry or high level scaffold was also built for putting in the cross girders and floor of the bridge, the pieces being suspended with block and tackle from cross beams placed on this gantry. After the span was erected and bolted up, the bolts had then to be replaced by rivets. The air was led to pneumatic riveters in pipes from a compressor stationed on the river bank. The compressor was driven by steam supplied by an ordinary locomotive boiler.

The span was supported by four lifting stools, each stool having four legs. The legs of these stools were in reality C. I. pipes 16 ft. long, which were inserted into other pipes of slightly larger diameter (10 in.), built into the concrete hearting of the large cylinders. The span was by this means really supported on the grillage. The legs of the stools, as stated, did not fit tight into the pipes but an annular space was left into which dry sand was afterwards filled—this arrangement forming what might be termed a "sand ram," its function being to take the weight off the bridge. For lifting the bridge, four 100 ton hydraulic jacks were used. These jacks were placed one on the center of each cylinder, their bases resting on the top of the concrete, while the bridge rested on the heads of these jacks. When the hydraulic jacks were pumped up, dry sand was trickled down the pipes forming the "sand ram;" thus the sand by getting underneath the cast iron legs of the stool supported the load temporarily until another lift could be taken with the hydraulic jacks. By raising each end of the bridge in this way, 12 in. at a time, a height was ultimately attained sufficient to allow of another 4 ft. height of cylinder and pipes being added. The cylinders were composed of three segments, and these were bolted together, forming a complete length of cylinder 4 ft. high. The pipes round the legs of the stool, which were also cast in segments, were also bolted up, and immediately thereafter the added length of cylinder was filled with concrete. All four cylinders were built up in this way simultaneously. After the concrete in the cylinders had been given sufficient time to set, the hydraulic jacks were again placed upon the top of the concrete—now 4 ft. higher—and the same operation was repeated. The bridge was lifted 16 ft. in this way, until it was finally seated on the box girders placed on the tops of the cylinders.

The bridge was tested on the 5th of October with a load equal to twice the ordinary working load. The result of this test showed that the deflection of the bridge at midspan was normal, and there was no settlement of any of the piers.

The structure has the longest simple span in South Africa, and has been built in a little over two years at a cost of about $110,000.

The main span, which is 230 ft. between centers of bearings, weighs 226 English tons and is designed to carry the heaviest engines.

The Altoona & Northern is said to have incorporated in Pennsylvania to build and operate a railroad from Wopsononock to Patton. The capital stock is $60,000.

The construction of the first 15 miles of the projected line of the Arkansas Northwestern will be done under the supervision of the Benton County Construction Co. of Bentonville, Ark. C. E. McClure, Porter Bldg., Bentonville, Ark., is president of the Arkansas Northwestern.

The Ashley, Drew & Monticello is now operating from Crossett to Fountain, Ark., and will construct an extension to Monticello. Upon the completion of this work another miles of second track from Woods, Pa., to Culmerville.
branch will be built to Rison, a distance of about 15 miles.

The Bessemer & Lake Erie, it is reported, is building 3.7

The Canadian Northern, it is reported, has awarded a contract to Murdoch & Company, Vancouver, B. C., for work on 40 miles from the north end of Cowichan lake to the Alberni canal. The line from Edmonston, Alta., north to Morinville has been extended north to Athabasca Landing, 72 miles.

The Canadian Pacific, it is reported, will build two additional tracks on about 600 miles of its lines between Brander, Man., and Lake Superior ports. The company will also double track a large portion of its lines between these ports and Montreal, Que.

Surveys are now being made for the proposed line of the Carolina & Georgia which was recently chartered to build from Columbia to North Augusta. G. E. Shand, Columbia, S. C., is chief engineer of the Co.

The Central Ontario, it is reported, has some of the work finished on a line from Wallace, Ont., to Whitney.

The Chicago & Alton is said to have had plans completed for an extension from Peoria, Ill., to Canton, a distance of about 20 miles. The funds for this work will come out of the $20,000,000 bond issue which was recently approved.

The Chicago, Burlington & Quincy has awarded a contract to Robert Malone, Lincoln, Neb., for building a new grade between Peru and Barney, 4½ miles.

The Chicago, Milwaukee & Puget Sound is said to have awarded a contract to Twohy Brothers for the construction of a line between Great Falls and Agawam, a distance of about 60 miles.

The Chicago, Milwaukee & St. Paul has awarded a contract to the Walsh Construction Co. for two million yards of excavation on double-track work between Muscatine, Iowa, and Ottumwa.

The Denver & Rio Grande will probably let contracts this month for the double track detour line around Soldier Summit in Utah, a distance of about 15 miles.

The De Queen & Eastern, it is reported, has made surveys for building an extension from Dierks, Ark., northeast to Hot Springs, 60 miles.

The Denver, Northwestern & Pacific, is reported, to have taken bids for the extension of its line from Steamboat Springs.

The Elberton & Eastern has awarded a contract to J. F. Cogan & Co., New York, to build from Elberton, Ga., southeast to Tignall, 21 miles. An extension is also projected from Tignall east to Lincolnton, 18 miles.

Work is now under way on the extension of the Elkin & Allegheny from Thurmond, N. C., towards Sparta. The work is being done by the company using convict labor, and three miles of grading have been finished.

The Grand Trunk is working on plans for extensions to its yards at Hamilton, Ont.

— NIGHT EDITION —

The Engineer's Distress.

A MULE TALE

By Paul M. LaBach

1

A mule stood on the loading chute,
The car he would not tread,
They tied a halter on the brute
And beat him on the head;
Yet obstinate and braced he stood
As born the land to rule,
A creature of Missouri blood,
A cornfed "ornery" mule

2

They prayed and swore, he would not go,
To reason he was blind,
He was consistent. could he know
The time to change his mind?
The loaders to the owner came,
The critters bound to stay
We're willing to take the blame
And feed him up on hay.

3

His owner from the fence replied,
"Your work's about to fail
As every other scheme was tried
You've got to twist his tail
And make him move, or you'll get canned"
The green-horn, brave and pale
Then nearer drew, with outstretched hand,
To twist that hybrid's tail.

4

There came a sudden jarring sound;
The man! Oh where was he?
Ask of the wind thats blowing round
The limbs upon the tree.
Never a word or sound was heard,
The sailor never lit,
So the fans passed around the word;
"Score mule a four base hit."

L'ENVOI

Freinds took the hero, badly bored.
And put him in a stall
Under the place pop-corn was stored,
In bins along the wall.
A fire did pop, in masses while,
The corn which fell beneath.
Thinking it snow, the mule took fright
And promptly froze to death.

Fall Weather Concrete Work.

THE MONTH of November always works the windup of a great deal of concrete work, and favorable weather is necessary for its proper completion at this time of year when no provision is made for heating materials and water during cold spells. If concreting is to be carried on during the winter, provision for heating materials is generally made early in November, but where a job is to be finished at this time all energy is spent in rushing the work with consequent neglect of this precaution, which is followed, in some cases, by disastrous results.

According to the weather bureau report, there were nearly twenty days of sunshine, comparative absence of storm, rain and snow and an average temperature of about 43 degrees F. during the month of November. The temperature was below freezing for a few short periods only. Consequently concrete work has been carried on continuously under the most favorable circumstances which could be expected at this time of the year, and it is safe to say that more concrete was placed in this locality during the past month than for the same month of any preceding year. The one drawback to such weather is that the concrete foreman is very likely to become careless after being humored by the weather and be caught unprepared for a cold snap, and as a result suffer a considerable loss of time and money by not being able to pour concrete, which he could do if the sand, gravel or stone and water could be heated readily.

No matter how fine the weather may be, the concrete constructor should be prepared to meet any sudden drops in temperature after the middle of November. Alternate freezing and thawing of concrete which has not attained its final set is dangerous and can be avoided at a very little extra outlay by heating the concrete mixture before placing and protecting it after placing, so that it will attain is final set before its temperature is lowered to the freezing point.

LOCOMOTIVE COALING STATION, P. & R. R. R.

A locomotive coaling station of reinforced concrete of 2,000 tons capacity spanning 7 tracks has recently been completed at the Green St. yard of the Philadephia and Reading Ry., at Philadelphia in connection with track elevation work in and about the city.

The building is supported on seven rows of 5 columns each and one end walk transversely, the rows of columns being placed parallel to outer lines of tracks. The floor of the pockets is of sufficient height above the top of rail to permit the largest engines can take on coal and dump ashes. The frame work of the building is of structural steel and the walls, partitions and floors of coal pockets are of reinforced concrete. The building is divided into 12 pockets equipped with 2 coal chutes each, and machinery for handling 100 tons of coal per hour. The ash handling machinery has a capacity of 250 yds. per 10 hour day.

Coal is dumped from cars into a hopper located below the track at the west end of the building, from which it is elevated and distributed to the pockets by machinery installed by the Link Belt Co., the contractor for the station.

COST OF CONCRETE AT PANAMA.

The Report of Colonel George W. Goethals, Chairman of the Ishmian Canal Commission Showing Cost of Concrete on the Panama Canal During Fiscal Year Ending June 30, 1912.

A TOTAL of 1,443,570 cu. yds. of masonry was laid in locks and spillways of the Panama Canal during the year as against 1,741,908 cu. yds. during the previous fiscal year. The unit costs for concrete masonry were as follows: Gatun Locks, $7.7552; Gatun Spillway, $7.0988; Pedro Miguel Locks, $6.4640; Miraflores Locks, $4.7675. At Pedro Miguel, where the decrease in plain concrete laid was 363,609 cu. yds., the cost increase was $1.0143, while at Miraflores, with an increase of 456,163 cu. yds., the cost decreased $0.0959. At the Gatun Locks the cost shows an increase of $0.5398, the amount laid being 512,315 cu. yds. less than previous year. The labor costs for plain concrete for the year shows that the lowest cost was attained at Miraflores at $0.8394, at Gatun Locks $1.3840, Pedro Miguel Locks $1.4733 and $1.5425 at Gatun Spillway.

The lower costs in the Pacific division are due to the lower cost of cement, stone and sand. The cement is shipped in bulk direct to the work, while in the Atlantic division it is shipped in bags and passes through the cement shed, the extra handling increasing the cost. On the Pacific division, stone in storage bins costs $0.7996, while at Gatun it costs $2.4952, more than three times as much. The cost of sand for two divisions varies about the same, i. e., $2.2414 for Atlantic division and $0.7025 for Pacific division.

At Gatun 83,670 lin. ft. of concrete piling was driven at a cost of $1.5719 per lineal foot, or $0.7088 per lineal foot less than the cost in place for previous years.

The Palacios, San Antonio & Pecos Valley is said to have secured the necessary capital for beginning construction on its proposed line from Palacios to Yoakum. H. W. Dean, Palacios, Tex., is the promoter.

The Quanah Acme & Pacific is reported to have been authorized to use bonds to the amount of $10,000,000, the proceeds of which will be used to build a connection with the Santa Fe in Texas.

The Sydney & Louisburg, it is reported, is building a one mile extension from Summit, N. S., to Waterford Lake, and is making surveys for an additional extension of one mile from Waterford Lake to Victoria Mines.

The South Atlantic & Western is reported to have been incorporated in North Carolina to build a railway between Knoxville, Tenn., and Rutherfordton, N. C. H. R. Nickerson, of Asheville, N. C., is president.

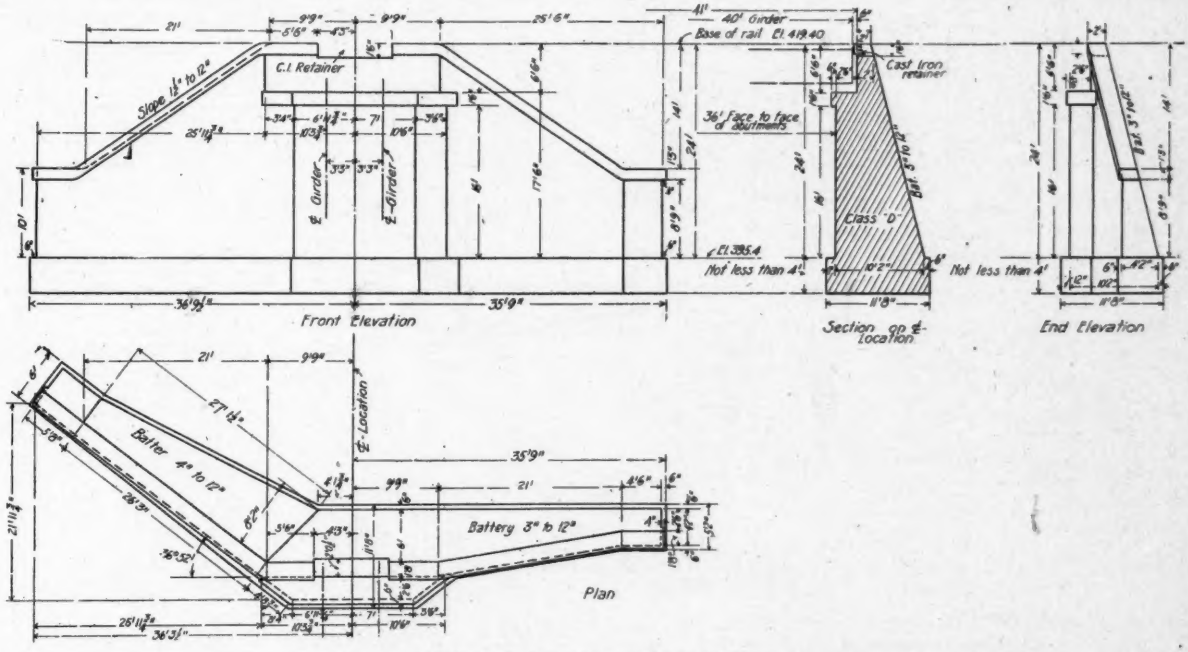
Concrete Practice, No. 5, C., C., C. & St. L. Ry. Co.

A. M. Wolf.

The concrete structures herein described and illustrated are such as have been generally adopted as standard and used extensively by the Big Four Ry.

Combination Straight and Wing Abutment.

The plain concrete abutment shown is a combination straight and wing abutment built of concrete of a 1:3:6 mixture, if crushed stone is used, or 1 part cement and 6½ parts of gravel in which stone and sand have been brought to the above proportions. The faces of abutments and wings are vertical, the back of straight portion being battered 3 ins. in 12 ins. and that of wing 4 ins. in 12 ins. The bridge seat is 3 ft. 0 in. wide and about 14 ft. long at face, with an 18-in. coping projecting 6 ins. beyond face of abutment. The backwall is 2 ft. 0 in. wide on top, the face being vertical and back battered 3 ins. in 12 ins. A portion of backwall, 1 ft. 6 ins. in height and 8 ft. 6 ins. wide, is omitted at the center, a cast iron retainer being used to retain fill and ballast. This portion of backwall is omitted so that the temporary track need not be interfered with until bridge is completed.



Combination Straight and Wing Abutment.

The wing walls are 1 ft. 8 ins. wide at the top under coping, which projects 4 ins. beyond face of wings. The ratio of width of base to height is in general about 40 per cent. The footing projects 12 ins. at face and 6 ins. at back of abutment and varies in height as to nature of soil, but in no case is less than 4 ft.

Wing walls in general are not designed by formula, but the base is usually made from 0.4 to .5, the height depending on conditions of surcharge, skew, etc. These ratios of thickness refer to ratio at middle of the length. The ratio at the point where the wing wall joins the abutment is made not less than ⅓ and usually about 0.4.

The forces assumed in design are: Dead load of substructure, concrete at 150 lbs. per cubic foot and dead load reactions. Allowable bearing on concrete assumed as 500 lbs. per sq. inch.

Reinforced Concrete Arch Bridge.

The arch bridge shown is a double track structure of the circular arch type, with plain concrete gravity spandrels and wing walls. It has been the policy of the Big Four Ry. for some years past to use no plain concrete arches, but to use reinforcement in all arch rings in a manner similar to that here shown. This reinforcement is not sufficient to be considered strictly a reinforced arch ring, but it is enough to prevent expansion and settlement cracks and give the concrete some tensile strength. Stresses in the arch ring are not figured for such structures of ordinary span length, but for spans of 75 ft. or more the stresses are figured and the arch ring designed as a reinforced elastic arch.

The arch ring is 2 ft. 6 ins. thick at the crown. The radius of intrados is 20 ft., that of extrados is 29 ft. to a point 14 ft. 10 ins. from top of abutment, this portion having a straight

Plain Concrete Bridge Piers.

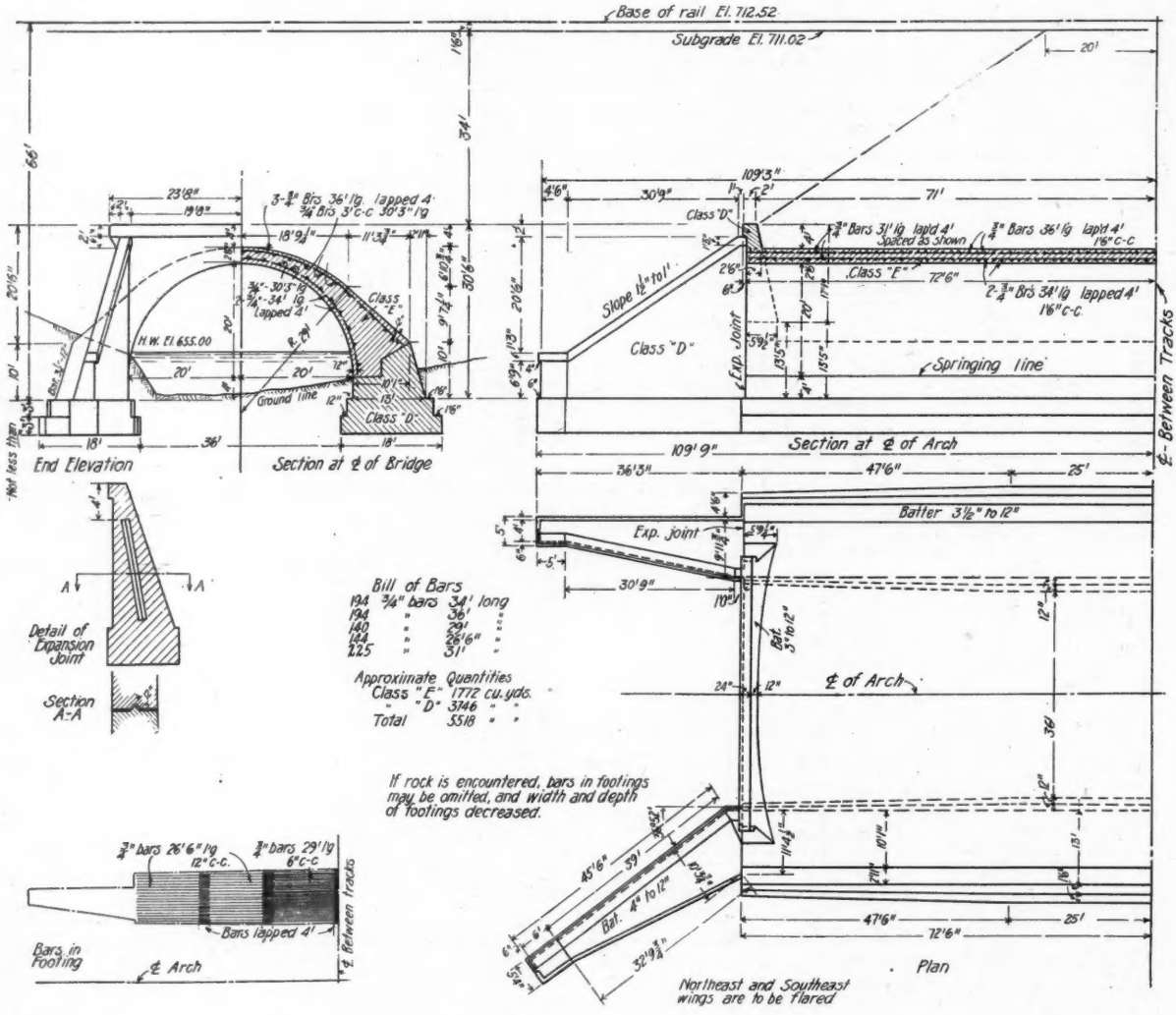
The concrete pier shown is the standard type used. The pier has a batter of ⅜ in. in 12 ins. with ends rounded to a radius of 3 ft. 6 ins. under the bridge seat coping, top thickness of pier being 7 ft. under coping which projects 6 ins. The width of pier is 30 ft. on top. The footing is built in two courses, each with a projection of 1 ft. 3 ins, the top course being 2 ft. thick and the lower not less than 6 ft. The corners of footing courses are cut off, so as to keep the projection nearly uniform. The ratio of base width to height is about 40 per cent.

Class "C" or 1:3:6, stone concrete is used in footings and main portion of pier, and Class E, 1:2:4 concrete for bridge seat. The forces assumed in design are as given for abut-

slope. The rise of arch from ground and springing line is 20 ft. The height from springing line to base of rail is 62 ft. The length overall between parapets is 146 ft.

The transverse reinforcement for the arch ring consists of ¾ in. square medium steel bars spaced 1 ft. 6 ins. in centers near extrados and intrados of arch. Three-quarter inch longitudinal distributing bars are spaced 3 ft. centers directly under transverse bars near extrados and also just above transverse bars near intrados, staggered with the upper bars. The bars do not extend into the abutments, but extend only to construction point between arch ring and depth of footings decreased. The back of abutment has a batter of 3½ ins. in 12 ins.

The parapet wall is of plain concrete, with a top width of 2 ft. at top of coping, which projects 6 ins. beyond face of arch and parapet. The parapet has a vertical face and back batter of 3½ ins. in 12 ins. The straight wings have a vertical face and a 3½-in. back batter, while the flared wings have a batter of 4 ins. in 12 ins. The wings have a coping 1 ft. 3 ins. thick projecting 4 ins. beyond face. The wing footings are not reinforced in any case. Concrete used in wings and parapets was a 1:3:5 mix. A 12-in. V-shaped groove



Reinforced Concrete Arch Bridge.

abutment. Class "E," a 1:2:4 mixture of stone concrete was used in arch ring.

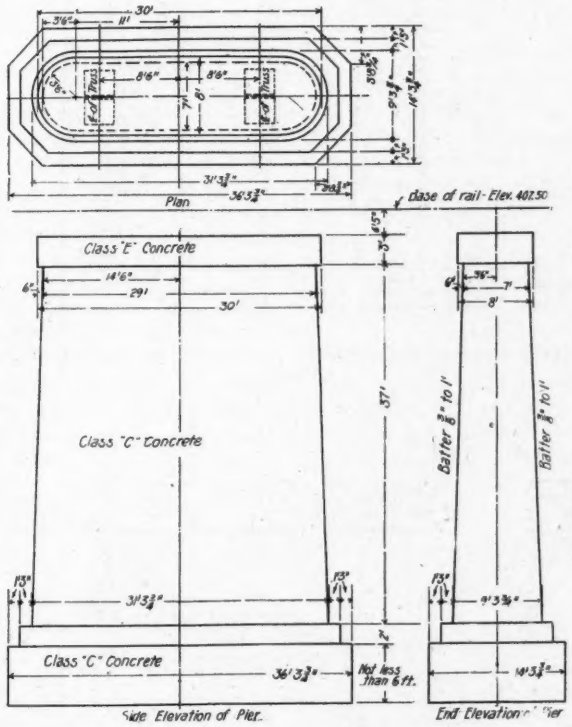
The abutment is of Class "D," gravel concrete of proportions equivalent to a 1:3:6 stone concrete. The footing is stepped in two courses, the projections of courses being 1 ft. inside the arch at center portion, tapering to 6 ins. near ends of arch and 1 ft. 6 ins. at the back of abutment, tapering to 1 ft. at ends, courses being not less than 3 ft. thick. The footings are reinforced transverse to track with ¾ in. square bars, 6-in. centers, 29 ft. long, lapped 4 ft.; on each side of center line of track, the spacing of bars in remainder of footing being 12-in. centers. Where rock is encountered, bars in footings are omitted and width and expansion joint, a detail of which is shown, is made between arch barrel and wing walls. This expansion joint at middle of wall extends from a point 1 ft. from top of footing to within 4 ft. of top of wing wall. The V-shaped groove, 12 ins. on a side, is formed in end of culvert barrel when poured. When the wings are poured this groove is filled, with the exception of a small space as shown, which is filled with tar paper or a similar pliable material.

Reinforced Concrete Culvert.

The culvert shown has a clear span of 16 ft. between abutments, with a height of 9 ft. 6 ins. from top of footing to bottom of cover slab.

The footings are 5 ft. 6½ ins. wide, projecting 6 ins. beyond inside and outside face of side walls or abutments. The thickness of footings is in no case made less than 4 ft. The side walls have a vertical face up to slab fillet and a batter of 3 ins. to 1 ft. for the back of walls. The walls are built up to within 1 ft. 6 ins. of bottom of cover slab, where a construction joint is formed, the slab and fillets being poured in one operation, after the abutments have been placed. Short ¾-in. sq. x 7-in. stub bars are placed in abutment parallel with face of fillet on 24-in. centers. These bars tie the slab to the walls and also act as shear reinforcement. Class "D" gravel concrete was used in footings and side walls. The ratio of base width to height is nearly 50 per cent for side walls and wings.

The cover slab is of 1:2:4 stone concrete, 2 ft. 7 ins. thick at center and 2 ft. 5 ins. thick at sides, thus giving a 2-in. pitch toward the sides for drainage. The top edges of slab have a 6-in. bevel. The main slab reinforcement consists of



Plain Concrete Pier.

1 in. square, twisted or corrugated straight and bent up bars spaced 4-in. centers for a distance of 5 ft. 8 ins. on either side of center line of culvert; in the remaining 4 ft. on each side 6-in. spacing is used. The bent-up bars provide diagonal tension reinforcement. Extra ¾ in. square bars are placed in top of slab transversely, 24 ins. on centers. The longitudinal reinforced consists of ¾ in. bars in top and bottom of slab, spaced as shown on section of culvert. The top of slab is 1 ft. 5 ins. below base of rail.

The parapet wall extends 9 ins. above top of slab at center and has a width of 2 ft. The depth of parapet at face is 1 ft. 4 ins., and top of parapet is 8 ins. below base of rail. The end of parapet projects 1 ft. beyond the back of abutments,

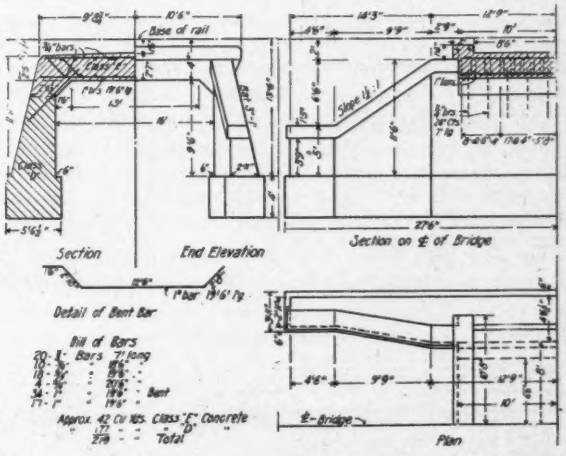
The wing walls are a continuation of side walls or abutments, the back of wall at footing being a straight line. This results in an outward flare of wings as the height decreases. A portion 4 ft. 6 ins. long at the end is of uniform height and is parallel to center line of bridge. The wings have a coping 1 ft. 8 ins. wide by 1 ft. 3 ins. deep. The slope of top of coping is 1½ to 1, with the exception of a level portion 2 ft. 9 ins. long at the face of bridge, and the level portion at end of wall.

The loading used in design was Cooper's E-60, with full impact for live loads and earth fill and ballast at 100 lbs. and concrete 150 lbs. per cu. ft. for dead loads.

The unit stresses used in design were, for concrete 700 lbs. per sq. in. compression and 50 lbs. shear. The tensile stress in steel was assumed at 16,000 lbs. per square inch, the concrete to take no tension whatever. Reinforcing steel used was medium steel, square, twisted or corrugated bars. Corrugated bars are in general preferred.

Reinforced Concrete Viaduct.

The structure, the details of which are shown, is a standard type of single track bridge used by this road where the line runs through the low, marshy bottom lands of southern Illinois. Several of these structures have been



Reinforced Concrete Culvert.

built, the longest being 1,217 ft. 9 ins. in length, consisting of fifty-two 20-ft. spans (clear span).

The loading and unit stresses used in design were the same as for reinforced concrete culvert just described.

The footings for piers and abutments are of 1:4:8 gravel concrete. The use of that mixture has been discontinued, however, since this structure was built. In the abutments, which are of plain concrete, a 1:6½ mix of gravel concrete was used. The reinforced concrete piers are of a 1:6½ mix of gravel concrete up to the bottom of fillet of the girders. The girders and floor slab are a crushed stone concrete of a 1:2:4 mixture.

The abutments have a back batter of 1 in. to 1 ft. and a face and side batter of ½ in., with a top width of 5 ft., and are 20 ft. long at top where a pressure or expansion joint is placed. The pressure joints, details of which are shown, are composed of old rails weighing 60 to 67 lbs. per yard. Five pieces of rail are placed with head up, in the top of the abutment, projecting ⅛ in. above the surface of the concrete. In the portion of the slab resting on the abutment three pieces of rail are placed with head down, projecting ⅛ in. below concrete, so as to bear on rails in top of abutment three pieces of rail are placed with head down, project faces, which are finished true and smooth. The joints are

filled with layers of felt. At every fourth pier which is of same dimensions as abutments and unreinforced, a similar expansion or pressure joint is placed. The vertical joint left between the slabs at expansion piers is filled with two layers of felt between surfaces of concrete which have a smooth, flat finish. The felt is carried up within 2 ins. of top of joint, the remaining space being filled with asphalt.

The reinforced concrete piers have a top width of 2 ft. 3 ins. and are 14 ft. long. The face batter is ½ in. to 1 ft., the ends being vertical. The bottom widths, depending on height of piers, are shown in the table accompanying the drawings. The footings for piers project 1 ft. beyond base of piers; the depths of footings are as shown in table. Three-quarter inch stub bars 4 ft. long, 18-in. centers, are placed in footings to transfer stress from ¾ in. pier bars, which are spaced 18-in. centers within 3 ins. of faces of piers. These bars extend well up into the girders and slab.

The girders are 5 ft. 4 ins. deep and 2 ft. wide, the floor slab, an average of 1 ft. 9 ins. deep, joining the girders at mid depth. At the connection with piers and abutments the girders have a fillet of 1-ft. 6-in. radius. The faces of girders and piers are panelled to relieve the monotony of a plain surface, thereby adding much to the beauty of the structure. The abutments and expansion piers which project beyond line of girders have heavy copings with cove reveals, giving the structure an appearance of added strength and stability.

The girders are reinforced with four 1¼-in. square bars continuous over four spans in bottom of girder, and three 1¼-in. square bars bent up at ends into top of girder. The top of girders are reinforced with three ¾ in. bars continuous over four spans between expansion joints.

The floor slab slopes 6 ins. from one pier to another for drainage, the thickness being 2 ft. at one end and 1 ft. 6 ins.

H	A	B	C	D
10'0"	5' 4 3/4"	2' 6 3/16"	5' 3 3/16"	20' 3 3/16"
10'5"	5' 5 1/8"	2' 6 7/16"	5' 3 7/16"	20' 3 7/16"
10'6"	5' 5 1/2"	2' 6 11/16"	5' 3 11/16"	20' 3 11/16"
10'9"	5' 5 7/8"	2' 6 15/16"	5' 3 15/16"	20' 3 15/16"
11'0"	5' 6 1/4"	2' 7 3/16"	5' 4 3/16"	20' 4 3/16"
11'3"	5' 6 5/8"	2' 7 7/16"	5' 4 7/16"	20' 4 7/16"
11'6"	5' 7"	2' 7 11/16"	5' 4 11/16"	20' 4 11/16"
11'9"	5' 7 3/8"	2' 7 15/16"	5' 4 15/16"	20' 4 15/16"
12'0"	5' 7 3/4"	2' 8 3/16"	5' 5 3/16"	20' 5 3/16"
12'3"	5' 8 1/8"	2' 8 7/16"	5' 5 7/16"	20' 5 7/16"
12'6"	5' 8 1/2"	2' 8 11/16"	5' 5 11/16"	20' 5 11/16"
12'9"	5' 8 7/8"	2' 8 15/16"	5' 5 15/16"	20' 5 15/16"
13'0"	5' 9 1/4"	2' 9 3/16"	5' 6 3/16"	20' 6 3/16"
13'3"	5' 9 5/8"	2' 9 7/16"	5' 6 7/16"	20' 6 7/16"
13'6"	5' 10"	2' 9 11/16"	5' 6 11/16"	20' 6 11/16"
13'9"	5' 10 3/8"	2' 9 15/16"	5' 6 15/16"	20' 6 15/16"
14'0"	5' 10 3/4"	2' 10 3/16"	5' 7 3/16"	20' 7 3/16"
14'3"	5' 11 1/8"	2' 10 7/16"	5' 7 7/16"	20' 7 7/16"
14'6"	5' 11 1/2"	2' 10 11/16"	5' 7 11/16"	20' 7 11/16"

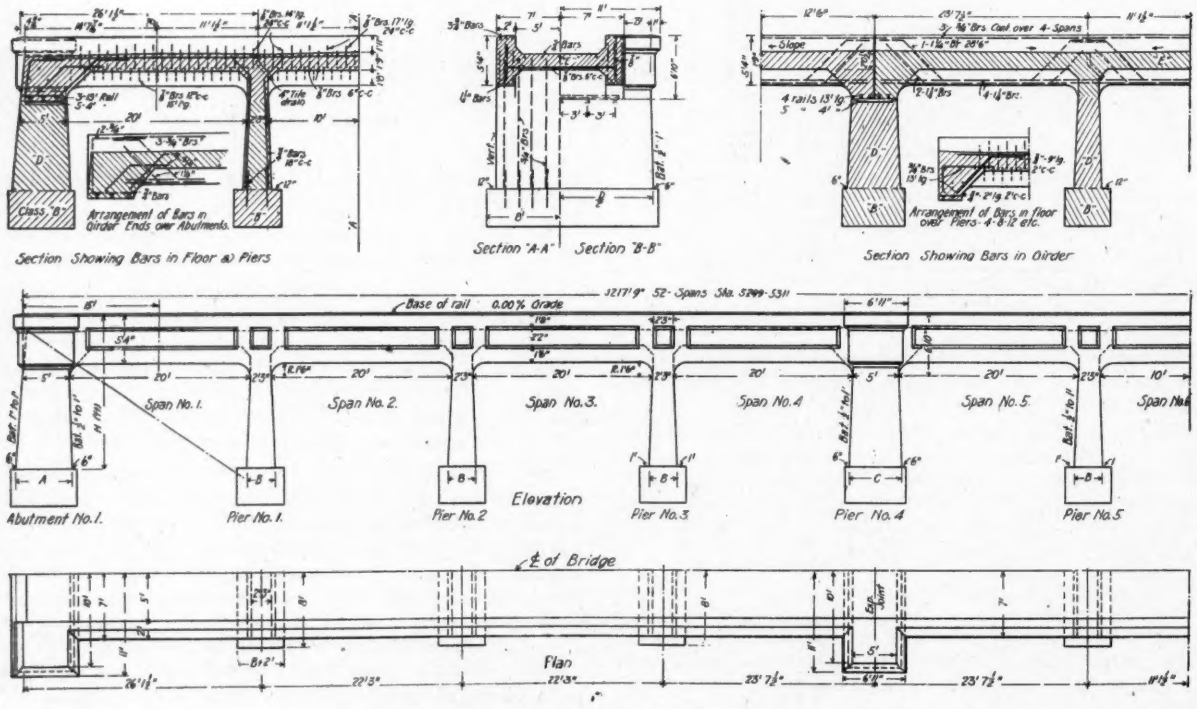
H = Height in feet from top of foundation or neat line, to base of rail.

Bridge 254

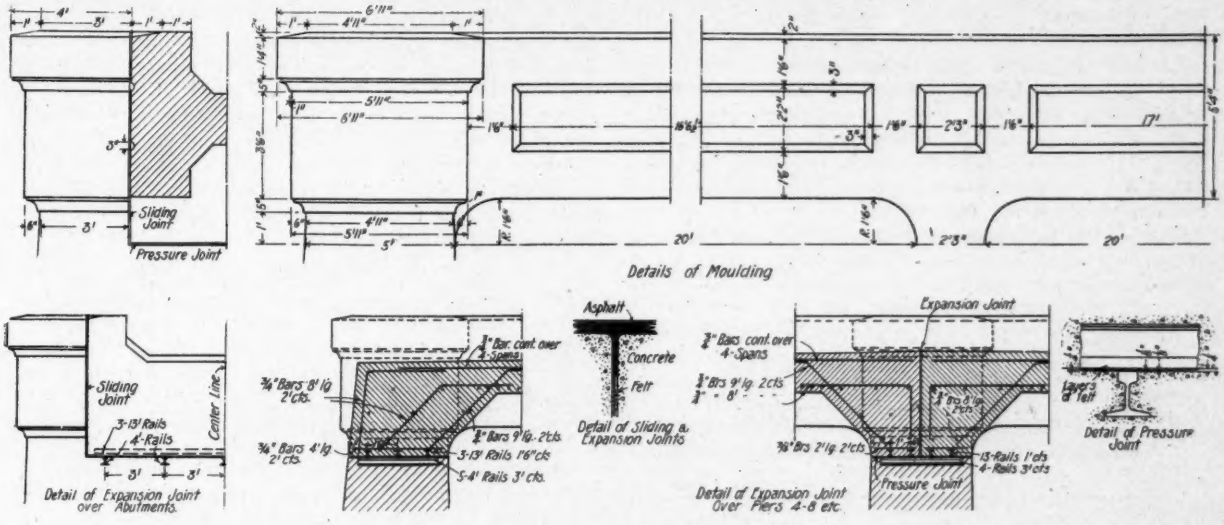
Pier No.	Depth of Footing	Pier No.	Depth of Footing	Pier No.	Depth of Footing
1	4'	17	4'	33	5'2"
2	4'	18	4'2"	34	5'2"
3	4'	19	3'9"	35	5'8"
4	4'	20	4'	36	5'3"
5	4'	21	4'	37	6'
6	4'3"	22	4'5"	38	6'
7	4'6"	23	4'6"	39	6'
8	4'4"	24	4'7"	40	5'9"
9	4'6"	25	4'6"	41	5'
10	4'2"	26	4'7"	42	4'6"
11	4'	27	5'9"	43	5'
12	4'	28	5'9"	44	4'6"
13	4'	29	4'8"	45	3'10"
14	4'	30	5'	46	3'10"
15	4'	31	5'	47	4'
16	4'7"	32	5'	48	2'9"
				49	2'6"

Pier No. 1. - North abutment and numbered South. Pier 49 - South Abutment

Tables of Dimensions of Piers and Abutments, Reinforced Concrete Viaduct.



Part Plan, Elevation, and Details, Reinforced Concrete Viaduct.



Details, Reinforced Concrete Viaduct.

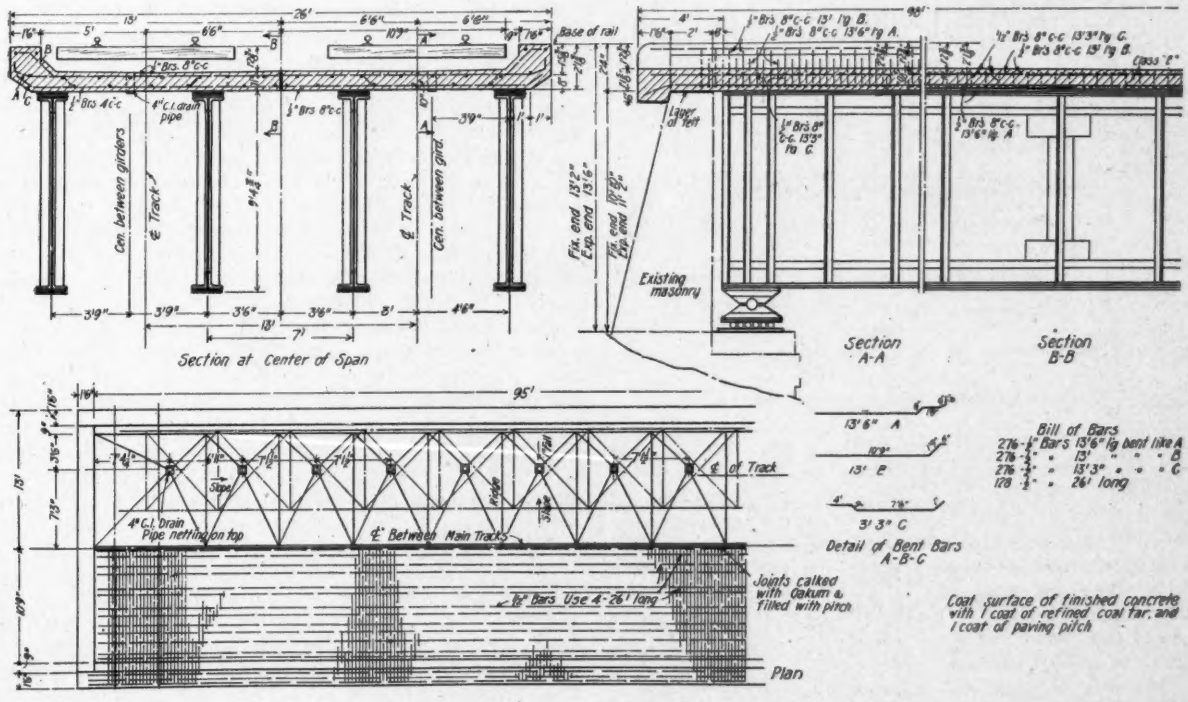
at the other. The floor slab is reinforced transversely in bottom with ⅞ in. square bars on 6-in. centers. One-half of these bars bend up into girders at the connection and the others bend down. Longitudinal bars (¾ in. sqquare) are placed 2 ft. centers in top of slab continuous over four spans. At the expansion joints and abutments extra bent bars are placed, both transverse and longitudinal, in slabs and girders to transmit loads to pressure joints and to provide extra shear reinforcement. The details of reinforcement are clearly shown in the accompanying plans.

The connection of slab to girders is made with a 45-degree fillet at top and bottom of slab. The trough formed by girders coming above top of floor slab is 1 ft. 11 ins. deep and 10 ft. wide. The depth of ballast under ties is about 15 ins. Some difficulty has been experienced in removing ties on account of closeness of the parapet walls to ends of ties. It has been found, however, that the ties can be removed with little difficulty by raising track sufficiently so that by sloughing the ties, they can be withdrawn.

Reinforced Concrete Bridge Floors.

Floor for Deck Plate Girder Span.

This type of floor is standard for nearly all deck structures. The concrete used in this type of floor is a 1:2:4 mixture, with stone used as the coarse aggregate. The floors are designed for Cooper's E-60 loading with full impact. The allowable stress in steel, which is in general corrugated or twisted square bars, is 16,000 lbs. per square

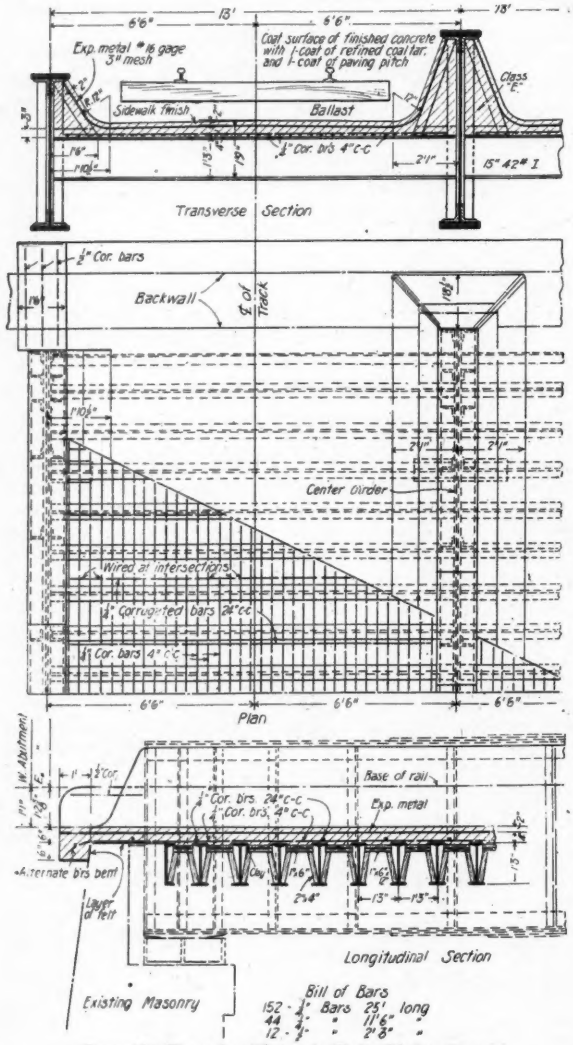

Section at Center of Span
Base of rail
Existing masonry
Section A-A
Section B-B
Bill of Bars
Detail of Bent Bars A-B-C
Plan
Joints caulked with Oakum & filled with pitch
Coat surface of finished concrete with 1 coat of refined coal tar, and 1 coat of paving pitch

Concrete Floor for Deck Girder Spans.

inch in tension. Stresses in concrete are assumed as 700 lbs. compression and 50 lbs. per square inch shear.

These floors are in general built in place. On double track bridges one-half of the floor is laid while traffic is kept up over the other track. In one case where neither track could be given up during construction of floor the floor was built on a 40-ft. girder span supported on blocking at the side of track and when sufficiently hardened was slid into place between trains.

The floor is built in two longitudinal sections pitched as shown in plan, so as to drain to the 4-in. C. I. drain pipes, spaced about 7-ft. centers at center line between girders.



Concrete Floor for Through Plate Girder Spans.

The tops of drains are covered with engine netting. The slab is 11 ins. thick, except where the slope necessitated to afford drainage cuts into slab, the thickness at the downspouts being 10 ins. The two longitudinal sections of slab floor are not connected in any way at the joint on center line between tracks, but the joint is calked with oakum and filled with pitch. At the outside the slab has a parapet about 2 ft. high over all and 1 ft. 2 ins. above top of slab. It is 1 ft. 6 ins. wide on top, to retain ballast, which is about 8 ins. deep under ties.

The slab is reinforced transversely with ½ in. square bars, bent as shown in plans, spaced 4-in. centers in bottom of slab between girders and ½ in. bars, 8-in. centers in top of slab between girders. At points near the girders one-half of the bars in bottom of slab are bent up so that the spacing is 4-in. centers for bars in top at parapet and inside. One-half inch square longitudinal bars, continuous are placed about 1 ft. 6-in. to 1 ft. 9-in. centers in top and bottom of slab to act as distributing and supporting bars. At the ends of bridge the slabs are rounded off and made to project down over masonry back walls. The surface of finished concrete is coated with one coat of refined coal tar and one coat of paving pitch.

Floor for Through-Plate Girder Spans.

This type of floor is designed for same loading as one for deck spans and the same unit stresses are employed in design.

The slab resting directly on floor beams is made 4 ins. thick at center line of track and 3 ins. at sides to provide for drainage, with a 2-in. sidewalk finish placed upon same. A layer of No. 16 gage 3-in. mesh expanded metal is placed on base before finish is put on. The main reinforcement in bottom of slab consists of ¼ in. corrugated bars 4-in. centers placed longitudinally with ¼ in. bars, 24-in. centers, transversely directly above, these acting as distributing bars. The concrete is brought up to the top flange of girders, the surface conforming to the inclined plane of plate and angle lateral braces, and the 2-in. finish is continued up to top of girders. This forms a trough section for retaining track ballast. At the end of bridge the slab extends over the back wall and a parapet 13 ins. high, reinforced with ½ in. bars longitudinally, forms a continuation of trough section to connect with fill at the back of back wall. The slabs are waterproofed in the same manner as deck girder slabs.

Reinforced Concrete Overhead Highway Bridge.

The bridge shown is of the beam and slab type, supported by reinforced concrete columns. The live load used in design was one 15-ton road roller or 100 lbs. per square foot, whichever gave the higher result for part in question. Unit stresses used were 16,000 lbs. tension in steel, 700 lbs. compression and 50 lbs. shear in concrete.

The footings of columns and the abutments are of Class "D" gravel concrete, consisting of 1 part cement and 6½ parts of gravel, in which stone and sand have been brought to the proportions of 6 to 3. The columns are of Class "C" stone concrete of a 1:3:6 mix. The slab, beams and girders are of Class "E" 1:2:4 stone concrete.

The abutments are of plain concrete with vertical face and back batter of 2 ins. in 1 ft. The column footings are of plain concrete and stepped. The bottom course is square and 2 ft. thick, projecting 1 ft. beyond the upper course, which is of same thickness as lower course. Stub bars are placed in upper course of footings to transfer stress from column bars to the footings.

The columns are reinforced with four 1 in. square bars 4 ins. from face, which extend well up into transverse girders. The long columns next to tracks are 3 ft. wide at face of bottom and 2 ft. wide at top, with a thickness parallel to tracks of 3 ft. The columns for short spans have a face width 2 ft. 6 in. at the bottom and 2 ft. at top, with a depth of 2 ft. 6 in. At the top the columns connect with cross girders and longitudinal girders, with a fillet of 3-ft. 6-in. radius, giving the bridge an appearance of a series of flat arches.

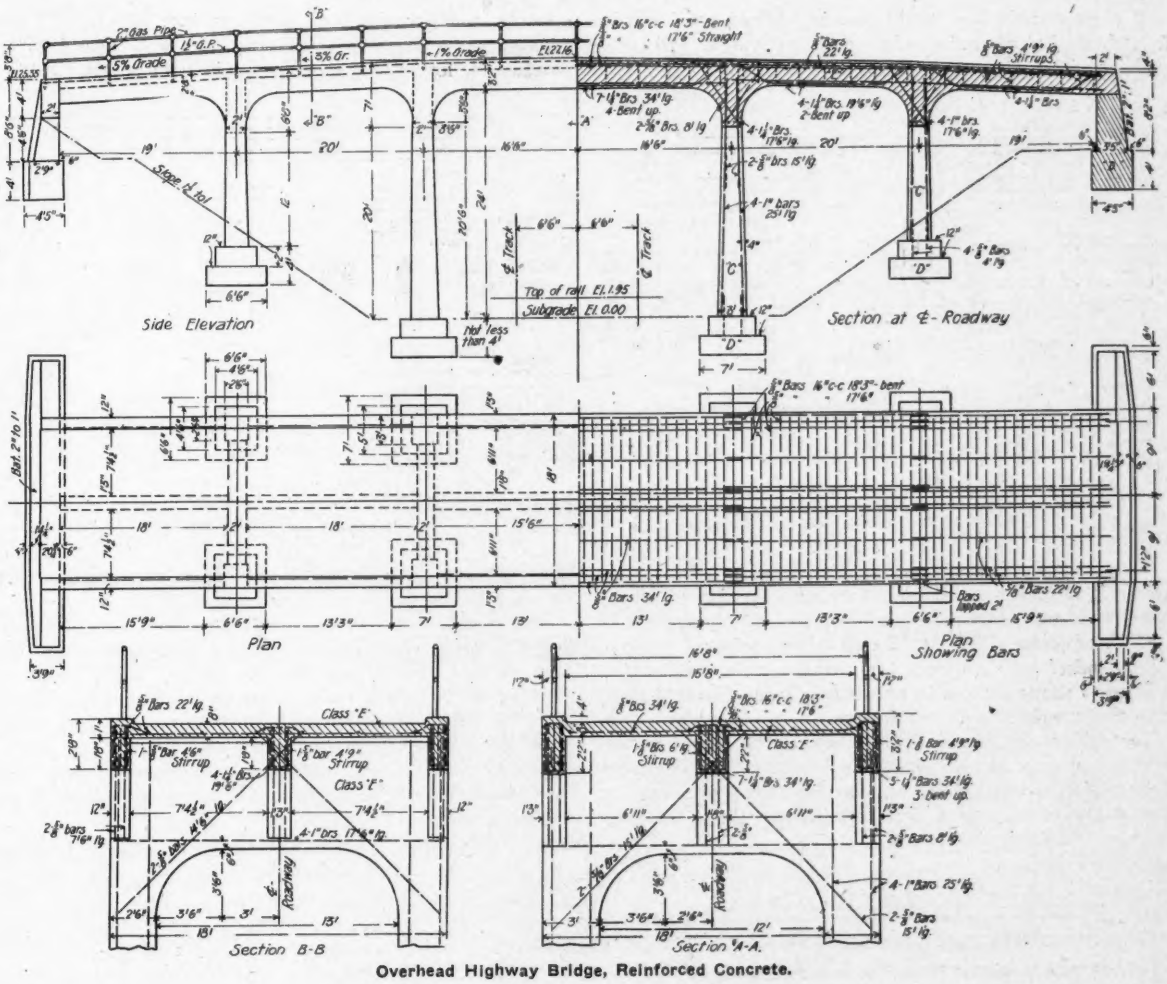
The cross girders at top of columns of long spans are 6 ft. 8 ins. deep and 2 ft. wide, with a clear span of 12 ft. reinforced with four 1¼-in. straight bars 6 ins. above bottom. Two ⅝ in. shear bars are placed at 45 degrees in fillet and extend nearly to top of roadway slab. The cross girders connecting short columns are 6 ft. 4 ins. deep, 2 ft. wide, with a clear span of 13 ft., and are similarly reinforced.

The short span fascia girders of 18-ft. clear span are 1 ft. wide at the bottom and 2 ft. 8 ins. deep, projecting 4 ins. above the slab to form a curb. These girders are reinforced in bottom with five 1 in. bars, three being bent up at about the 1-6 point of span. Two ⅝ in. bars are placed in tops of girders and are continuous through bridge. The girders are reinforced for shear with ⅝ in. bar stirrups placed at varying spacing throughout the girders as shown on plans. At connection with columns the fillets are reinforced with two ⅝ in. shear bars. The center beam between cross girders for short spans is of same depth as fascia girders, but is 1 ft. 3 ins. wide, with four 1¼-in. bars in bottom, two being bent up at ends, the remainder of reinforcement is similar to that of fascia girders.

centers 3 ins. above bottom of girder and the bars in second layer are 4 ins. above that. The bars are placed so as not to be nearer to sides of girder than 2½ ins. to center of bar.

The deck slab is 8 ins. thick, with spans of 6 ft. 11 ins. and 7 ft. 4 ins., the main reinforcement consisting of ⅝ in. square bars, spaced 8-in. centers, spanning transversely, alternate bars being bent up into top of slab over beams and girders. Five-eighths inch longitudinal bars, spaced 3 ft. 2 ins. centers act as distributing bars. Bars are lapped 2 ft. at the splices, which is equivalent to a lap of 40 diameters, to develope the strength of the bar.

The deck slab forming roadway has a grade of 5 per cent ascending on both end spans and a 3 per cent grade on spans next to ends, changing to a 1 per cent grade inter-



Overhead Highway Bridge, Reinforced Concrete.

The long span girders have a clear span of 31 ft. The fascia girders are 1 ft. 3 ins. wide and 3 ft. 2 ins. deep at center and slightly shallower at columns, due to the 1 per cent ascending grade from both ends on this span. The main reinforcement consists of five 1¼-in. bars, three being bent up about 3 ft. from columns. The reinforcement in top and also the shear reinforcement is similar to that of short span girders. The center beam for the track span is 1 ft. 8 ins. wide and same depth as fascia girders, with a corresponding fillet at connection with girders. The reinforcement consists of seven 1¼-in. bars in bottom, four bent up at ends, and two ⅝ in. bars continuous in top. The shear reinforcement is similar to that of the girders. The horizontal bars in bottoms of all girders are placed with

secting at the center of main span. This affords a clearance of 22 ft. above the top of rail.

A gas pipe hand rail 3 ft. 8 ins. high is placed on the curbs. The roadway is 15 ft. 8 ins. wide between curbs and is unpaved, the concrete slab serving as pavement. The entire structure is a fine example of a reinforced highway bridge.

Comments.

The standards of the Big Four Railway, as shown and described herein, demonstrate very clearly that the concrete work of this road has reached a high standard and is strictly in keeping with best modern practice.

We are indebted to Mr. G. P. Smith, chief engineer, for plans and information from which this article was written.

The Signal Department

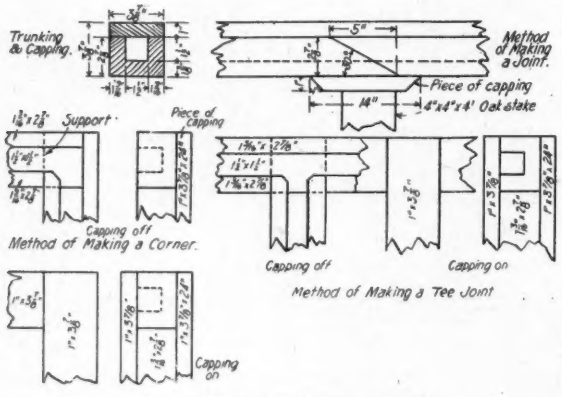
STANDARD SIGNAL PRACTICE ON THE L. & N.

B. W. Meisel.

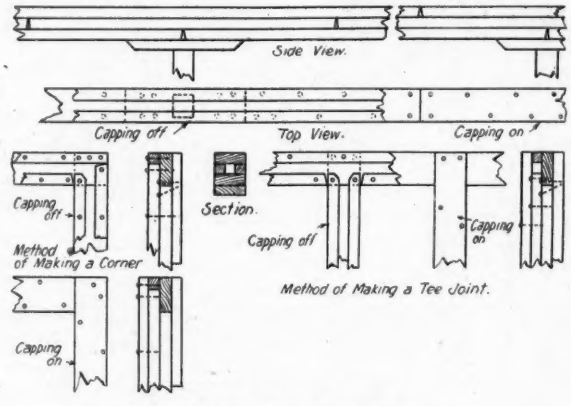
The Wire Joint.

One of the most difficult problems in signal work, and at the same time a very important consideration in all classes of work where the conveyance of electrical energy is necessary, is the making of a wire joint. This is especially true in signal practice, where reliable operation is required, and where the current in most cases is very small. Temporary joints should never be allowed, since such work, quite often, remains in service for a considerable length of time, and in some cases becomes permanent.

In order that the best results may be attained, the Louisville & Nashville has adopted the following specifications and standard for wire joints:



Standard 1½-Inch Groove Trunking.



Standard Built-up Trunking.

"Prepare and thoroughly clean wire (Figure 1) for joint, according to dimensions shown. Care must be taken to prevent injury from small cuts and nicks."

"Twisted joints (Figure 2) are to be well soldered, by pouring on melted solder, using a non-corrosive resin flux."

Figure 3 shows the first layer of rubber tape. Figure 4 shows the joint completed with rubber tape.

The rubber tape is required to be put on under tension, stretched to about half its width, care being taken to have everything perfectly clean. After applying the rubber tape, sufficient heat is applied to form a tight covering, care being taken not to injure the material.

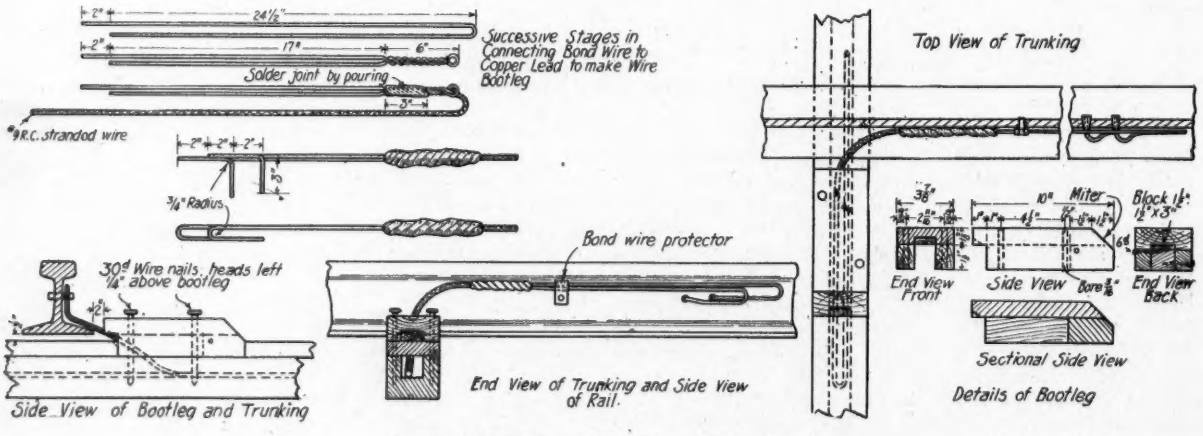
Figure 5 shows a layer of ¾ in. adhesive cloth tape, with about ½ lap. The outside of the joint is required to be painted with an even coat of insulating paint. Joints exposed to the weather are required to have two coats of insulating paint, the braid not to be removed until the joint is soldered.

The next important joint which forms an essential part of present signal practice is the wire joint in bootlegs, of which there are many forms now in use on the different railroads throughout the country. The following is the standard practice on the L. & N. and gives the successive stages in connecting bond wires to the copper leads to make the wire bootleg.

A 52 in. copper clad bond wire is used and bent into the form shown in the illustration. One leg of the U shaped wire is made 2 in. longer than the other. The wire is then twisted to form a ½ in. eye at the bend, with five complete turns between it and the ends, this to cover a distance of 6 in.

The next step is to fasten the No. 9 stranded wire to the bond wire. This is accomplished by passing the stripped and cleaned end of the stranded wire through the eye of the bond wire, making five complete turns about the bond wire so that the stranded wire will follow the twist of the bond. This joint is then soldered for a distance of not less than 3 in. by pouring. Then the entire joint is covered with two layers of rubber tape and two layers of friction tape, and painted with P. & B. preservative compound.

The ends of the bond wire are bent into the form shown,


Successive Stages in Connecting Bond Wire to Copper Lead to make Wire Bootleg
Solder joint by pouring
No. 9 R.C. stranded wire
¾" Radius
Bond wire protector
30d Wire nails, heads left ¼" above bootleg
Side View of Bootleg and Trunking
End View of Trunking and Side View of Rail.
Top View of Trunking
10° Miter
Block 1½" x 1½" x 3½"
End View Front
Side View
End View Back
Sectional Side View
Details of Bootleg

Standard Booting and Wire Connection to Rail.

bonded into the track and clamped to same, near joint end, by means of a bond wire protector.

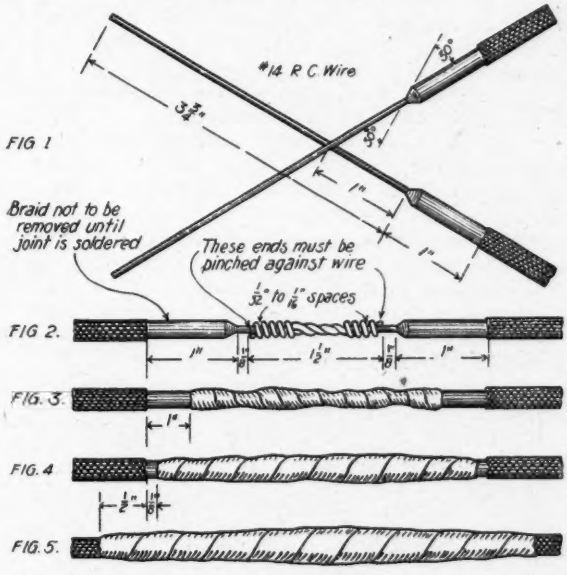
The wire leading into the bootleg and trunking is looped back upon itself in the trunking so that future repairs may be easily and quickly made.

Details of Bootleg.

Another piece of apparatus peculiar to signal practice is the bootleg to be found in many forms and varieties and used as standard on the different railroads.

The one shown in detail herewith has been adopted as standard on the L. & N. A piece of standard trunking 3⅞x2⅞x10 in. is mitered and cut into the form shown. Four 3/16 in. holes are drilled into the sides; these holes receive 30d nails which are driven into the trunking upon which this cut piece fits groove down. The trunking cover is cut to fit and meet this cut piece after it is in place. The piece may be removed at any time by simply drawing the four 30d nails, thus allowing free access to the bootleg wire and loop at this point.

The ends of the No. 9 stranded wire which are to be fastened to the instruments, at binding posts, are equipped with copper terminals well soldered to the wire.



Standard Wire Joint.

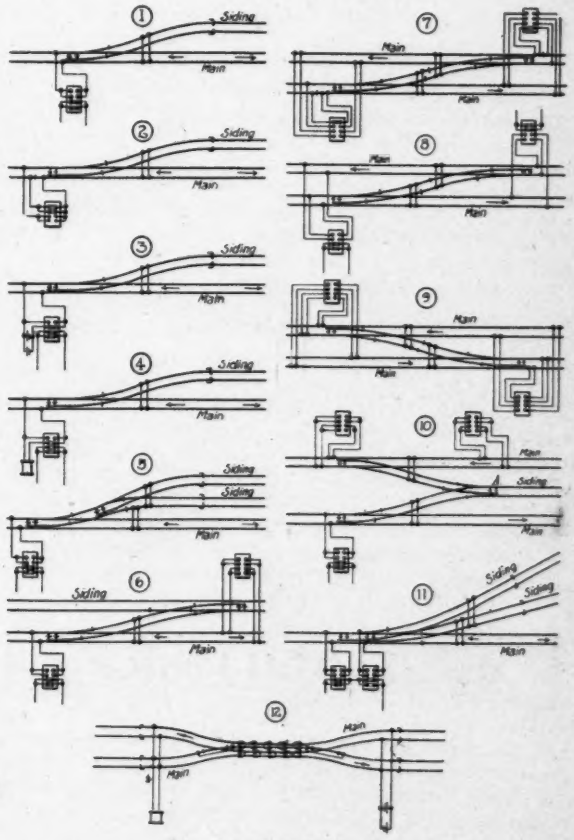
Standard 1½ In. Groove Trunking.

Specifications: Groove shall have smooth finish. Trunking shall be of sound yellow pine, in lengths of 12 ft. or more and shall have mitered ends. It shall contain no knots over ½ in. in diameter and they must be sound and hard. Surface of trunking is to be finished surfaced 2 sides and 2 edges. Nails must never be driven through trunking from the inside of the groove, nor shall they be driven into the groove from the outside. The bottom of line trunking shall not be less than 1 in. above the surface of the ground. At signal and relay boxes trunking is to fit tight and well under the case. Battery chute risers to be secured to chute, mitered and capped. Cap to clear lid of chute ¼ in. Trunking on poles to end 6 in. below signal cross arms, mitered and capped on top. Trunking shall be supported by stakes as large square as the trunking is wide, at intervals not greater than 6 ft. It shall be painted with 2 coats of white lead paint. Main run of trunking shall not be placed nearer than 6 ft. from gage side of rail except by special permission. One-third capacity of groove shall remain for future wires.

The diagrams shown herewith illustrate the methods of making corners and joints, showing the standard practice on the L. & N.

Built Up Trunking.

Specifications: Trunking shall be built of sound yellow pine or equally as good lumber in commercial size surfaced 2 sides and 2 edges. The lumber shall contain no knots over 1 in. in diameter and they must be sound and hard. Inside corners must be rounded and the cover shall be fastened with nails. Nails shall not be driven through the trunking from the inside of the



Standard Switch Circuits.

groove, nor shall they be driven into the groove from the outside. All joints must be staggered and each joint in the bottom of the trunking shall be supported by a stake. All joints in the capping must be made at least 1 ft. from the joints in the trunking. Trunking shall be supported on stakes, not over 5 ft. centers. A piece of capping of the width of the trunking and of sufficient length shall be placed between the trunking and the stakes. All stakes supporting trunking shall be placed vertically and extend at least 2 ft. below the surface of the ground unless otherwise specified. Stakes shall be of oak or concrete, 3x4 in. or equivalent circular section, and of sufficient length to allow them to be placed at least 2 ft. in the ground. Where ground or local conditions make it necessary, stakes will have to be long enough to give a good support. Where trunking exceeds a width of 7 in. a special arrangement consisting of a double line of stakes shall be installed. Trunking parallel to track shall not be placed nearer than 6 ft. to the nearest rail. Local conditions shall determine the height of the trunking above ground. In general, where it is parallel to the tracks, the bottom of the trunking shall be approximately 6 in. above ground. Trunking shall be painted with 2 coats of white lead paint. Not less than one-third the capacity of the groove shall remain free for further installation of wires.

The diagrams shown herewith illustrate the method of making joints, corners, and mounting built up trunking.

Standard Switch Insulation Circuits.

The following is the standard practice for switch insulation circuits:

Figure 1 is used where there is signal line control, and the line control should be broken through switch box at all facing point switches.

Figure 2 is used on facing point switches where there is no signal line control wire, with shunt relay and open battery.

Figure 3 is used where the battery is l cated near the switch.

Figure 4 is used where the relay is located near the switch.

Figures 5, 6, 8 and 11 are modifications of figure 1.

Figure 7 is a modification of figure 2.

Figure 9 is used where switch is trailing.

Figure 10 is a combination of figure 1 and figure 9. If the tracks are less than 12 ft. centers at point of switch "A," a short track section should be introduced and both signal control wires broken through the track relay of this section.

Figure 12 shows the connections and wiring at a gauntlet track.

The two connecting shunt wires are No. 9 B. W. G. copper clad insulated wires 3/64 in. wall insulation, single braid, located half way between the insulated joints in the outside rail of the side track.

The switch box in all cases is connected to the normally closed point and wherever possible, mounted on the side of the track.

The fastening to the joint should be made as close to the ends of the point as possible.

The standards described and illustrated herewith, being track connections mostly, show some very ingenious and efficient devices. We are indebted to Mr. A. R. Fugina, signal engineer of the Louisville & Nashville, for the information contained herein.

Personals

O. W. Pegee has resigned as chief engineer of the Alton, Jacksonville & Peoria Ry., at Alton, Ill.

C. Clerc has been elected president and general manager of the Arizona & Swansea River at Swansea, Ariz., succeeding George Mitchell.

F. A. Williams has been appointed division engineer of the Atchison Topeka & Santa Fe Ry. (western lines) with office at Los Vegas, N. M., succeeding B. H. Newlee. G. T. McNeill has been appointed roadmaster of the Coast Lines at Ludlow, Colo., and H. D. Young has been appointed roadmaster at Dalies, N. M.

G. F. Anderson has been appointed superintendent of bridge, building and way structures of the Santa Fe, Phoenix & Prescott Ry., a subsidiary of the A. T. & S. F.

J. W. Chadwick has been appointed general manager of the Augusta Northern Ry., office at Saluda, S. C.

K. D. Reeder has been appointed supervisor of bridges and buildings of the Birmingham Columbus & St. Andrews Ry., office at Chipley, Fla.

The jurisdiction of F. E. Whitcomb, signal engineer of the Boston & Albany R. R., at Boston, Mass., has been extended over the Telephone department.

F. C. Shepard, formerly construction engineer, has been appointed engineer of construction of the Boston & Maine R. R., succeeding B. T. Wheeler. The office is at Boston.

C. J. Wilson has been appointed superintendent of the Canadian Northern Ry., with office at Winnipeg, Man.

C. P. Hammond, formerly assistant engineer, has been appointed engineer maintenance of way of the Central of Georgia Ry., office at Savannah, Ga. R. R. Cinnmires has been appointed assistant engineer at Savannah succeeding L. V. Bean. H. H. Smith has been appointed tie and timber inspector at Savannah, Ga. S. A. E. Wilson has been appointed supervisor at Miller, Ga. C. B. Yancey has been appointed supervisor at Macon, Ga.

W. L. Bennett has been appointed supervisor of track of the Chesapeake & Ohio Ry., succeeding L. C. Grubbs, at Cabin Creek Jct., W. Va. L. C. Grubbs, supervisor of track, has been transferred to Hinton, W. Va., succeeding R. F. Severs.

John Colton has been appointed supervisor of the Chicago & Alton with office at Bloomington, Ill.

M. McFadden, roadmaster on the Chicago & Northwestern Ry., has been transferred from Chicago to Mason City, Ia., succeeding L. Flynn. D. A. Evans succeeds Mr. McFadden as roadmaster at Chicago.

J. R. Ritter has been appointed chief lumber inspector of the Chicago Burlington & Quincy R. R., with office at Chicago.

O. Johnson has been appointed roadmaster of the Chicago Great Western R. R. at Streator, Ill.

E. G. Atkins, formerly trainmaster, has been appointed superintendent of the Chicago, Milwaukee & St. Paul Ry., at La Crosse, Wis. F. E. King, formerly assistant engineer, has been appointed district carpenter at Minneapolis, Minn. E. C. Clothier has been appointed acting chief carpenter at Perry, Ia., succeeding O. Anderson.

E. Buehrlen has been appointed roadmaster of the Chicago Rock Island & Pacific Ry., at Eldon, Mo., succeeding V. M. Simpson, transferred. M. J. Farrell has been appointed roadmaster at Des Moines, Ia. C. M. Greene has been appointed roadmaster at Kansas City, Mo. C. A. Johnson has been appointed roadmaster at Oskaloosa, Ia. G. A. King has been appointed roadmaster at Albert Lea, Minn. D. Heffron roadmaster at Sheffield, Mo., has resigned. V. M. Simpson, roadmaster, has been transferred from Eldon to Windsor, Mo.

C. S. Sheldon has been appointed assistant engineer of the Cincinnati Hamilton & Dayton Ry., at Cincinnati, O.

M. H. Cahill has been appointed superintendent of the Delaware Lackawanna & Western Ry., at Buffalo, N. Y., succeeding G. A. Poore.

George H. Webb, chief engineer of the Michigan Central R. R., has been appointed also chief engineer of the Detroit Terminal R. R., office at Detroit, Mich.

G. R. Endert has been appointed chief engineer of the Detroit Toledo & Ironton Ry., office at Springfield, O.

F. W. Brooks has been appointed general manager of the Detroit United Ry., office at Detroit, Mich. Harry Bullen has been appointed general superintendent, with office at Detroit, Mich. John Kerwin has been appointed superintendent of tracks, also with office at Detroit, Mich.

J. P. Warren has been appointed roadmaster of the Eastern Texas R. R., with office at Tyler, Tex.

R. T. Greene has been appointed assistant of the El Paso & Southwestern System at Douglas, Ariz.

F. Kain has been appointed general manager of the Elk & Little Kanawha R. R., office at Gassaway, W. Va.

D. C. Morris has been appointed chief engineer of the Enid, Ochiltree & Western R. R., at Dalhart, Tex.

G. T. Benson has resigned as assistant supervisor of track of the Erie R. R., at Elmira, N. Y. W. J. Alynn has been appointed supervisor of track at Elmira, N. Y. J. Jordan has been appointed supervisor of track at Youngstown, O., succeeding F. W. Eckles. J. E. Fletcher, supervisor of track, has been transferred from Kent to Akron, O. W. H Nichols has been appointed supervisor of track at Jersey City, N. J.

A. Johnson has resigned the position of principal assistant engineer maintenance of way of the Florida East Coast Ry.

J. B. Hardy has been appointed roadmaster of the Galveston, Harrisburg & San Antonio Ry., at Rosenberg, Tex., succeeding W. A. Adams.

G. G. Moore has been appointed superintendent of the Galveston, Harrisburg & Henderson R. R., at Galveston, Tex., succeeding F. A. Lister.

C. Volz, formerly signal supervisor, has been appointed general signal foreman of the Great Northern Ry., office at St. Paul, Minn. W. E. Shepherd has been appointed signal supervisor at St. Paul, succeeding Mr. Volz. John S. Breit, assistant roadmaster, has been transferred from Churches Ferry to Berthold, N. D., succeeding Allen Eckstrom. John Check has been appointed assistant roadmaster at Churches Ferry vice J. S. Breit. T. Mika assistant roadmaster, has been transferred from Willmar, Minn., to Rutland, S. D., succeeding O. Erickson. P. Neeson, assistant roadmaster, has been transferred from Minneapolis to Garretson, S. D., succeeding A. Fiala. A. L. Ketcham has been appointed assistant roadmaster at Billings, Mont. J. R. McGarvey has been appointed assistant roadmaster at Bonners Ferry, Ida.

L. Southerland has been appointed roadmaster of the Houston & Texas Central R. R. at Hempstead, Tex., succeeding D. E. Pendleton. John Murphy has been appointed roadmaster at Ennis, Tex.

T. J. Foley, formerly assistant general manager, has been appointed general manager of the Illinois Central R. R., office at Chicago. Supervisors H. T. Smith at Bloomington, P. H. Leonard at Chicago, and J. G. O'Brien at Carbondale, Ill., have resigned. J. Pierce, supervisor, has been transferred from Freeport to Rockford, Ill.

J. B. Heafer has been appointed assistant general manager of the International & Great Northern R. R., office at Houston, Tex.

B. H. Bryant has been appointed locating engineer of the International Railways of Central America, succeeding E. M. Bulfinch. The office is at Joaquina, Guat.

F. M. Barker has been appointed superintendent of the Lehigh Valley R. R., at Wilkes Barre, Pa.

John Comb has been appointed supervisor of track of the Lehigh Valley R. R. at Towanda, Pa., succeeding J. J. Burke.

W. A. Hunicke has been appointed engineer of the Louisiana & Northwest R. R., with office at Homer, La.

J. C. Haskins has been appointed assistant engineer of the Louisville & Nashville R. R., at Paris, Tenn., succeeding G. K. Travis. J. F. Burns, roadmaster, has been transferred from Elizabethtown to Louisville, Ky. William Fugate has been appointed supervisor at Corbin, Ky. Samuel Thorpe has been appointed supervisor at Knoxville, Tenn., succeeding C. H. Mitchell.

T. L. Dunn, formerly chief engineer, has been appointed assistant to vice president and general manager of the Maine Central R. R., office at Portland, Me. B. T. Wheeler is now chief engineer.

C. A. Tanheiser has been appointed engineer of maintenance of the Missouri Kansas & Texas System, with office at Denison, Tex.

S. B. Fisher, chief engineer of the Missouri Kansas & Texas at St. Louis, has been appointed chief engineer of construction. A. M. Acheson, chief engineer of the Missouri Kansas & Texas Ry., of Texas, has been appointed also chief engineer operation of the Missouri Kansas & Texas Ry.

F. S. James has resigned as superintendent of the Missouri Kansas & Texas Ry., of Texas, at Greenville, Tex.

J. W. Welsh has been appointed roadmaster of the Missouri Pacific Ry., at Monro, La., succeeding M. P. Heapey.

M. Contreras has been appointed a superintendent of the National Rys., of Meico at Mexico, D. F. Louis Correa has been appointed division engineer at Mexico, D. F.

A. W. Seymour has been appointed office engineer in the signal department, exterior zone, of the New York Central & Hudson River R. R. succeeding G. A. Guyer. The office is at Albany, N. Y. G. A. Guyeer has been appointed signal supervisor at Albany, N. Y., succeeding H. C. Williams. W. H. Stillwell has been appointed signal inspector at Albany, N. Y.

R. J. Bond has been appointed supervisor of the Northern Central Ry., at Baltimore, Md., succeeding J. M. Kinkead. G. W. Curtiss has been appointed supervisor at Shamokin, Pa. H. B. Welsh has been appointed supervisor at York, Pa.

B. D. King has been appointed roadmaster of the Northern Ohio Ry., at Akron, O., succeeding D. P. Beatty.

W. N. Stump has been appointed supervisor of signals of the Pennsylvania R. R., at Oil City, Pa., succeeding Guy Toft. D. C. Baird supervisor has been transferred from Reading to Watsontown, Pa., succeeding J. E. McIntyre, who has been transferred to South Fork, Pa., succeeding J. W. Keenen. G. M. Ball, Jr., supervisor, has been transferred from Huntington, Pa., to Jersey City, N. J., succeeding J. F. Chandler. W. V. Betts, supervisor, has been transferred from Reynoldsville, Pa., to Dunkirk, N. Y., succeeding H. B. Welsh. W. B. Carpenter, supervisor, has been transferred from Freeport, Pa., to Reynoldsville, Pa., succeeding W. V. Betts, transferred. W. P. Critchfield has been appointed supervisor at Kittanning, Pa., succeeding H. H. Garrigues. J. M. Kinkead has been appointed supervisor Huntingdon, Pa., succeeding G. M. Ball, Jr., transferred. T. E. Lightfoot, supervisor, has been transferred from Osceola Mills to Reading, Pa., succeeding D. C. Baird, transferred. R. H. Orwig has been appointed supervisor at Blairsville, Pa., succeeding R. J. Bond. R. H. Pinkham has been appointed supervisor at New Florence, Pa., succeeding F. L. Pitcher. F. C. Putney has been appointed supervisor at Freeport, Pa., succeeding W. B. Carpenter, transferred. F. M. Robb, supervisor, has been transferred from Huntington, Pa., succeeding G. M. Ball, Jr., transferred. transferred. A. M. Williams has been appointed supervisor at Titusville, Pa., succeeding F. M. Robb, transferred.

H. Hall has been appointed assistant engineer of the Pennsylvania Lines West of Pittsburgh, office at Wayne, Ind. W. Hunter has been appointed master carpenter at Alliance, O., succeeding J. E. McFadden. G. R. Barry, division engineer, has been transferred from Zanesville to Toledo, O. M. P. Tucker has been appointed division engineer at Zanesville, O. G. Le Boutillier, division engineer, has been transferred from Cincinnati to Pittsburgh, Pa. E. F. Coes has been appointed division engineer at Cincinnati, O.

Wm. Madden, a division engineer of the Pere Marquette R. R., has been transferred from Port Huron to Grand Rapids, Mich., succeeding J. E. Johnson. W. J. Long, division engineer has been transferred from Grand Rapids to Detroit, Mich.

B. A. Ludgate has been appointed an assistant engineer of the Pittsburgh & Lake Erie R. R., at Pittsburgh, Pa.

E. R. Barnes has been appointed engineer of the Public Belt R. R., of New Orleans, office at New Orleans, La., succeeding A. F. Barclay.

J. P. Warren, formerly assistant roadmaster, has been appointed roadmaster of the St. Louis, Southwestern Ry., of Texas, office at Tyler, Tex. E. J. Bohannon has been appointed assistant roadmaster at Tyler, Tex. C. J. Marrs has resigned as assistant roadmaster at Lufkin, Tex.

J. F. Green has been appointed general roadmaster of the San Antonio, Uvalde & Gulf R. R., at San Antonio, Tex., vice T. H. Love.

J. C. McMahon has been appointed roadmaster of the San Pedro, Los Angeles, & Salt Lake R. R., at Milford, Utah, succeeding T. J. Brown.

B. T. Wheeler, recently appointed chief engineer of the Maine Central R. R., has been apponited also chief engineer of the Sandy River & Rangeley Lakes R. R.

C. E. Ervin, formerly assistant engineer, has been appointed roadmaster of the Southern Ry., at Atlanta, Ga., succeeding J. N. Biddy.

E. O. Corrigan, roadmaster of the Southern Pacific Co., has been transferred from Alameda Mole, to Oakland Pier, Cal. Jos. Greiler has been appointed roadmaster at Mina, Nev., succeeding A. E. Moquist.

W. L. Seddon, chief engineer of the Seaboard Air Line Ry., has been appointed also chief engineer of the Tampa Northern, office at Portsmouth, Va.

L. J. Hawkes has been appointed roadmaster of the Texas & New Orleans R. R., at Houston, Tex., succeeding P. Sweeney.

R. I. Wilby, formerly assistant engineer, has been appointed engineer maintenance of way of the Toledo Peoria & Western Ry., office at Peoria, Ill.

James Shea, formerly roadmaster of the St. Louis & San Francisco, has been appointed roadmaster of the St. Louis, San Francisco & Texas Ry., and the Ft. Worth & Rio Grande Ry., at Fort Worth Tex., succeeding D. C. King. Mr. King succeeds Mr. Shea as roadmaster at Wichita.

The Maintenance of Way Department

PENNSYLVANIA MAINTENANCE PRIZES AWARDED.

The Pennsylvania recently made its annual award of $5,400 in premiums for the maintenance of sections of roadbed in the best condition during the past year. General Manager S. C. Long, with a party of three hundred operating officers of the Pennsylvania, made the inspection, and awarded the premiums.

To insure the premiums being awarded upon accurate data, a committee of maintenance of way officers went over the line every month during the year in a car attached to one of the regular high speed trains. This special committee was composed of Joseph T. Richards, chief engineer of maintenance of way, Chairman; L. R. Zollinger, engineer of maintenance of way; Elisha Lee, assistant to the general manager; C. S. Krick, superintendent of the Manhattan division, and N. W. Smith, superintendent of the Central division.

The first premium, that of $1,200, of which $800 goes to the supervisor and $400 to the assistant supervisor having the best line and surface between New York and Pittsburgh and Philadelphia and Washington, was awarded to C. M. Wisman, supervisor, and William F. Miller, assistant supervisor, who have charge of the track between Tullytown, Pa., and Deans, N. J. The other prizes were:

Four premiums of $800 each, $600 for the supervisor and $200 for the assistant, for the best line and surface on a main line superintendent's division between New York and Pittsburgh and Philadelphia and Washington, awarded as follows: John Schimmel, Jr., supervisor; F. H. Bentley, assistant supervisor, in charge of track from Woodbine Avenue, West Philadelphia, to west of Coatesville. J. A. Burchenal, supervisor; E. C. Silvius, assistant supervisor, in charge of track from just west of Anderson, Pa., to east of Tompsontown, Pa. A. W. McCellan, supervisor; M. J. Jones, assistant supervisor, in charge of track from west of Wilmerding to west of Donohoe. George Goldie, Jr., supervisor; N. D. Vernon, assistant supervisor, in charge of track between Sixty-second Street, West Philadelphia, and Wilmington, Delaware. A special improvement premium of $1,000, $700 to the supervisor and $300 to the assistant, for the greatest improvement made in line and surface on the main line between New York and Pittsburgh and Philadelphia and Washington was awarded to Supervisor G. H. B. English and assistant supervisor H. J. Davall, who have charge of the track between Wilmington and Perryville, Maryland.

SPIKES DRIVEN INTO BORED HOLES.*

By J. A. Newlin, Engineer in Timber Tests. Report of Preliminary Tests.

Purpose of Tests.

In treating ties it is desirable, if possible, to have thorough penetration of the tie at the point where the spike is to be driven. It has been suggested that this might be accomplished by boring a hole in the tie before treatment, and driving the spike into the hole.

The tests described herein were made to determine the effect upon the resistance of the spike to withdrawal and the condition of the tie when the spike has been driven into various sized holes. These tests can only be considered as preliminary in answering the above questions.

Results of Tests.

The attached table gives the detailed results of the individual tests. The tests were made upon red oak ties in air-dried condition. A few of the ties were natural, a few treated with zinc chloride, and about one-half of them were treated with creosote by the Lowry process. Previous tests showed that the treatments had no effect upon the resistance of the spikes to withdrawal. About half of the spikes were driven by an expert trackman. The others were driven by a good, careful man. A special effort was made to have the spikes follow the holes.

The spikes used were nine-sixteenth-inch square and five and one-half inches long, and a few plain, cylindrical spikes nine-sixteenth inch in diameter and five and one-half inches long.

The first part of the table shows the results of the tests when the spikes were used with the ordinary point. The lower part of the table shows the results of the tests when the point of the spike was tapered on four sides. After the tests were made the ties were sawed in two at the holes and the condition of the tie examined. It was found that with the common point about half of the spikes did not follow the holes. The number not following the holes would likely be much larger than this in practice. When the spike does not follow the hole closely, its resistance to withdrawal is lowered, but when the spikes follow the holes the resistance to withdrawal is increased in the case of the 3/8-inch and 7-16-inch holes and for the half-inch holes the resistance is about the same as with no hole. This is plainly shown in the lower part of the table.

A few of the spikes which had been tapered on four sides

*From a report by the U. S. Forestry Department.

were driven into ties without any hole being bored. These spikes split the ties and showed very low resistance to withdrawal. The spikes tapered on four sides, driven into 7-16-inch and ½-inch holes left the ties in the best condition. There was not much tendency to split with the spikes tapered on four sides when driven into ⅜-inch holes.

A heavy oil was poured into a few half-inch holes and left for about sixteen hours before the spikes were driven into these holes. The resistance of the spike to withdrawal was considerably lessened by the oil.

Conclusion.

The common spike is not suitable for driving in bored holes, as the shape of the point tends to cause the spike to run out of the hole, and the resistance of the spike to withdrawal is lowered when the spike does not follow the hole. When the spike is tapered on four sides at the point, (which may easily and quickly be done with a small hammer) it almost invariably follows the hole when reasonable care is used. When the holes are bored after treatment, the resistance to withdrawal is increased (when the hole is not too large), and the tie is left in much better condition as to the splitting and crushing of the fibers. When the spike has been once tapered on four sides, it is rendered unfit to drive into a tie without having the hole bored. These conclusions may not hold for spikes driven into holes bored before treatment.

TABLE NO. 8. SPIKES DRIVEN IN BORED HOLES
SUMMARY OF PRELIMINARY TESTS PURDUE UNIVERSITY AUG. 4 1909

Settlement	Tie	Condition	No Hole Lbs.	Ordinary 9/16" Square Spikes								Round Spikes	
				7/8" Hole	Remarks	7/16" Hole	Remarks	1/2" Hole - With Oil	1/2" Hole - Without Oil	Remarks		1" Hole	1 1/4" Hole
50	23	Natural	7100	7400	Did not follow hole	6800			8000				
51	76	Treated Creo.	7650	6200	Followed Hole	7600	Followed hole		7400	Did not follow hole			
51	88	" "	9900	8000	" "	8950	" "		8800	Followed hole		6800	6590
50	86	Natural	7900	9450	" "	7450	Did not follow hole		7000	Did not follow hole		4950	
51	60	Treated Creo.	11000	9900	Followed fairly well	10100	" " " "		10600	Followed hole		5650	8100
51	61	" "	11200	8400	Did not follow hole	9200	" " " "		8650	" "			
51	84	" "	9250	9800	" " " "	8770	Followed hole		6400	" "		6900	6650
51	77	" "	8000	8000	" " " "	9100	" "		7140	Did not follow hole		4950	
50	53	Treated $ZnCl_2$	8100	6300	" " " "	7400	Did not follow hole		6400	" " " "			
50	65	" "	8100	8250	Followed fairly well	6300	Followed hole		6900	" " " "			
51	64	Treated Creo.	8900	6850	Did not follow hole	7300			6900	" " " "			
Average			8827	8050		8106			7154				
				9/16" Square Spikes, Point Tapered Four Sides									
50	81	Zinc Chloride	7250	7500	Followed hole	6450	Followed hole		6300	Followed hole		2850	6150
51	68	Creosote	8850	8900	" "	10100	" "		9050	" "		2600	
50	88	Zn. Chloride		6100	" "	5650	" "		4900	" "		6360	6000
50	85	" "		9000	" "	8300	" "		8400	" "			
51	41	Creosote	8900	8400	Followed hole fairly	10000	" "		8200	Did not follow hole			
50	28	Zn. Chloride	6900	7000	Followed hole				6100	Followed hole			
51	24	Creosote	9650	9650	" "	5600	" "		10250	" "			
50	84	Zn Chloride	7150	8750	" "	7600	" "		6300	" "		4350	
50	48	" "	6500	8000	" "	8150	" "		7900	" "		5200	
51	68	Creosote	7400	8300	" "	6400	Followed fairly well	6850	7900	Both followed holes			
50	86	Natural	7500	8500	" "	8700	" " "	6300	7150	" " "			
50	89	Zn. Chloride	8000	8650	" "	8300	Followed hole	7000	8550	" " "			
50	87	Natural	6100	6000	" "	6400	" "	4750	6000	" " "			
50	90	"	8200	9600	" "	9000	" "	6550	8600	" " "			
51	28	Creosote	5600	6150	" "	7200	" "	6600	7400	" " "			
51	37	"	5200	6250	" "	7700	" "	5700	6750	" " "			
51	59	"	9800	10550	" "	9700	" "	8200	9500	" " "			
51	68	"	8250	9900	Followed hole fairly	8300	" "	7700	8100	" " "			
Average			7613	8178		7856		6628	7664	" " "		5061	6698

Spikes Driven by Experienced Track Men

Tabulated Results of Tests on Holding Power of Spikes.

The Pennsylvania and the Lake Shore & Michigan Southern have submitted plans to the officials of Ashtabula, Ohio, for the construction of a bridge over the railway tracks on Prospect street. Estimated cost, $75,000.

The Pennsylvania, it is reported, has ordered 300 tons of bridge material from the Pennsylvania Steel Co. to be used in a bridge across the Bronx Kills for the Connecting R. R.

The San Antonio & Aransas Pass is preparing to erect a new passenger station to replace the building that was destroyed by fire some time ago at Corpus Christi, Tex.

The Southern Pacific Co., it is reported, will increase the capacity of its shops at Spark, Nev. About $40,000 worth of new machinery will be installed.

The Wabash, it is stated, has prepared plans for a new two-story passenger station and office building at Peru, Ind.

The Brinson Ry. has awarded a contract to the Westinghouse, Church, Kerr & Co. to build an extension to its railroad from Waynesboro, Ga., to St. Clair, a distance of about 15 miles. At the latter point the extension will connect with the Georgia & Florida. Work is reported to have been started.

The Industrial Car Co., of Cleveland, Ohio, has changed its name to the Electric Locomotive & Car Co. The company has recently added to its line of products and is now building electric cars and locomotives.

The Brier Hill Steel Co., of Youngstown, Ohio, is building a large warehouse at Niles, Ohio. It is expected to be finished about the first of the year.

The Chicago Bearing Metal Co. has purchased a site for a plant on West Forty-third street, in Chicago, Ill., on which it will erect a $200,000 factory.

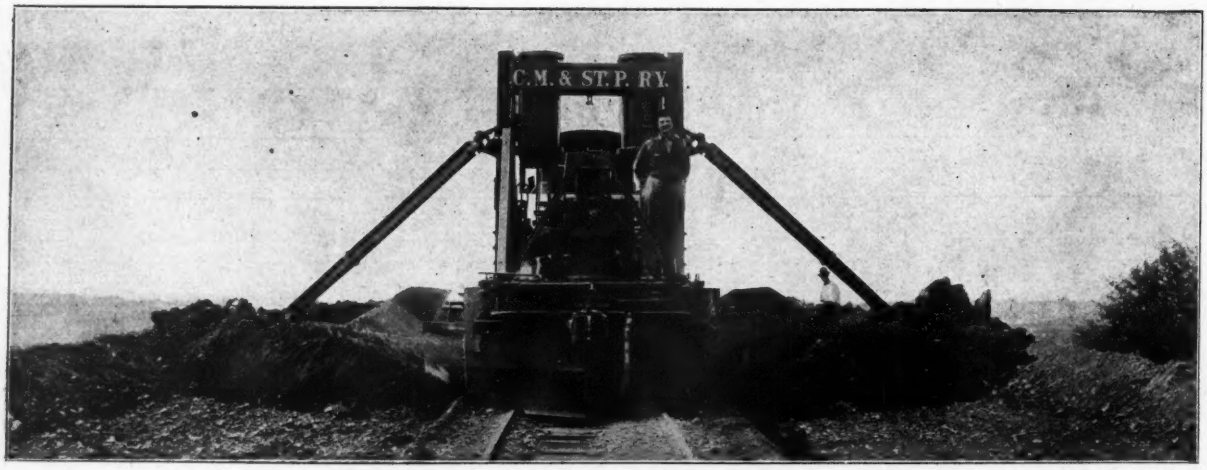
Edwin Strassburger has been made vice-president of the Buffalo Brake Beam Co., with office in St. Louis, Mo.

The Chicago, Milwaukee & St. Paul, it is said, has ordered 4,000 tons of bridge steel.

JORDAN DIRT SPREADER.

C. L. Van Auken.

During the construction season just ended, the Jordan Spreader demonstrated that it was a labor and cost saving device to the complete satisfaction of those in charge of the work of constructing a new hump yard near Chicago. This machine made possible the placing of almost 1,000,000 cu. yds. of filling in a season when labor was scarce and of an inferior quality. Without the Jordan spreader it would have been impossible under the existing conditions to have placed much more than one-half that amount.



Jordan Spreader.

A concrete idea of the enormous capacity of this machine as an embankment builder is conveyed by the following facts: The unloading crews unloaded a total of 429 H. & B. cars during one day of 24 hours, aggregating 10,700 cubic yards. The Jordan spreader easily "dozed" this enormous quantity of dirt, and moreover was idle at times waiting for the unloading crews.

No better compliment can be paid the spreader than the diligence with which those concerned with the progress of the construction worked upon the machine in case of derailment or accident, for it was realized that unless the "Jordan" was working that the steam shovels would soon "swamp" the yard with material. An old style "Bulldozer" was kept on the job to be used in case of emergency, but not one-quarter of the dirt could be moved and not one-quarter of the efficiency could be attained as was possible with the Jordan Spreader. The men who were on the ground all the time now consider the Jordan indispensable in construction of this kind.

The writer was responsible for the condition of the new dump being made by the Spreader and was highly pleased with the way in which it was possible to "doze" the dump to any desired level ranging from 24" below the bottom of tie to 17½" above the top of rail.

The spreader was manned by an ordinary train crew consisting of a locomotive engineer and fireman, a train conductor and two brakemen. During bad weather when the construction tracks were in poor condition and derailments were liable to occur, two Italian laborers were added to the crew.

The spreader used on the above work was operated 20 hours out of every 24 hours for four consecutive months without any serious delays for repairs.

ROADMASTERS AND MAINTENANCE OF WAY ASSOCIATION.

At a recent meeting of the Officers of the Roadmasters' Association the following subjects were assigned, and committees appointed for 1913: Contracting of Maintenance Work: John Barth, C. C. C. & St. L., Chairman; J. Burke, Erie; T. Hickey, M. C.; Guy Lowers, Erie; P. Madden, C. M. & St. P.; N. McNabb, M. C.; F. E. Crabbs, C. & N. W. New and Improved Appliances: W. H. Kofmehl, C. M. & St. P., Chairman; A. M. Clough, N. Y. C.; G. H. Brooks, St. Louis Terminals; J. P. Corcoran, C. & A.; Wm. Hazlewood, N. Y. C.; W. H. Cleveland, Santa Fe; G. M. Green, C. R. I. & P. Combined Organization of Maintenance Forces: Emmett Keough, C. B. & Q., Chairman; B. M. McDonald, N. Y. C.; A. E. Hanson, Santa Fe; B. C. Dougherty, C. M. & St. P.; J. P. McAndrews, C. & N. W.; F. B. Adams, P. & R.; C. Linehan, C. R. I. & P. The Use of Power Driven and Labor Saving Appliances: H. E. Astley, N. Y. C. & H. R., Chairman; Coleman King, Long Island; J. H. Anger, N. Y. C.; Z. B. Couch, L. & N.; J. W. Fletcher, Jr., Carolina & N. W.; J. W. Powers, N. Y. C.; Robert Faries, Penn Lines. Prevention of Accidents, Personal and Otherwise, Viewed from the Maintenance Standpoint: J. R. Coulston, L. E. & W., Chairman; C. J. Coon, N. Y. C.; J. J. Hughes, St. Louis Terminals; Henry Ferguson, G. T.; D. E. Lynch, C. B. & Q.; G. D. Gifford, N. Y. C.; Frank Button, C. & N. W.; T. H. Gaffney, M. Pac.; Geo. Barnoski, C. M. & St. P.

Application has been made in Canada for an act authorizing the Canadian Northern to build a line from Montreal, Que., east to Sherbrooke, 110 miles.

Plans of the Canadian Northern, calling for the construction of a line from Cowichan Lake through Alberni, New Castle, Nelson and Comax district, have been approved.

The Canadian Pacific, it is reported, will build two additional tracks on 600 miles to make a four-track system between Brandon, Man., and Lake Superior ports; the company will also soon begin double-tracking the main line between lake ports and Montreal.

ROADMASTER'S REPORT ON SECTION MOTOR CARS.

The complete discussion given before the Roadmasters and Maintenance of Way Association at the annual convention on the motor car question was omitted from our October issue on account of lack of space, but the opinions given are important and we give herewith the complete discussion as published in the Proceedings. The report as published on page 486 of the October issue of *Railway Engineering* stated the following as the recommendation of the committee:

"A gasoline motor car of simple two cycle design weighing 650 to 700 lbs. is recommended. It should be so constructed that it can be propelled the same way as an ordinary hand car in case of breakdown."

Discussion.

Mr. Kerwin—I don't think there is such a car as the one described.

President—I would like to ask this gentleman if he is using any section motor cars that have a contrivance for hand propelling. I have been using motor cars for quite a long time, probably as long as any of the others, and I never saw the time when it was necessary to operate the car by hand, and when it would pay to have a car of this kind. Gasoline engines meet all the requirements without the hand operating feature.

D. O'Hern (E. J. & E.)—We have two types of car. Both of them run well. They are an economy to any company, a saving in labor, and in my judgment there is no better thing that I have struck on the railroad through which to cut down expenses than one of these cars.

L. C. Ryan (C. & N. W.)—Motion has been made and seconded that this paragraph be accepted, but I believe that if the gentleman who made the motion and also the man who seconded it would read this over carefully, they would be willing to withdraw the motion. If we accept this and approve of it, we would be accepting a two-cycle type of an engine on a hand car; we would have a motor car that could be turned into a hand pumping car at any time. We are accepting one car. I think it would be better to accept this as information; say we approve of using motor hand cars, but not designate as yet what kind to use.

Jos. Buel (Ark. Cent.)—We have been using gasoline motor cars the past four years on our line, but we have no two-cycle engine with a hand lever. We use motor cars and we have had a very good success with them and only a few failures. We are getting better acquainted with them every day and better service out of them. At first it is hard to get acquainted with the car, but the more we studied them the more we found out that they were a necessity. They are economical. We have eliminated every other section and we also save a foreman's pay. I don't mean to say that that is a good plan. I don't think there should be increased mileage; neither do I recommend it. I tried to fight it, but it was run over me. We are getting along very well with a gasoline motor car.

John Barth (C. C. C. & St. L.)—I call that all good talk and all good figuring except this business of putting a section and a half on a man because he has a gasoline motor. I don't think you ought to increase the mileage on account of a gasoline motor car or take any of the men off. It is a simple matter of fact that the foreman may gain half an hour in the morning and work his men half an hour later in the evening and they are rested up when they go to the job in the morning, but I don't believe in having two men do three men's work.

J. E. McNeal (A. T. & S. F.)—We tried the combination hand car with a gasoline engine and we didn't like them. They didn't have power enough and were a little too complicated. We finally settled down to the two-cycle gasoline cars. They were less complicated and we had no trouble operating them. We have not lengthened the sections any. We figure we gain by saving time; the men stay with us better and are in better shape to go to work. We have a man go over the road and inspect the cars. We are increasing the number all the time and we feel it is a good investment. But we couldn't get along with the combination cars. "Gasoline cars" save us time and we have no trouble with them at all.

Coleman King (L. I.)—As an amendment I would recommend that the paragraph stand as read with the elimination of the words "two-cycle," and read "gasoline motor cars of simple design," and cut out entirely the last clause, reading that they should be so constructed that they can be propelled the same as a regular hand car in the case of the engine breaking down.

Secretary read paragraph 7 as amended:

"Motor Hand Cars for Section Men and Extra Gangs. A gasoline hand car of simple design weighing from 650 to 700 pounds, is one of the latest innovations in the maintenance of way department and when placed in the hands of a reasonably intelligent foreman is a good investment and is recommended. Place them in the hands of each foreman first who in the estimation of the roadmaster is capable of handling them properly and it will be only a short time when every foreman will study their mechanism and all will be able to handle them as easily as the common hand car."

The paragraph was adopted as amended.

A MAINTENANCE OF WAY SERMON.

By Andrew Palm, Roadmaster W. P. Ry.

Text:—As ye sow, so shall ye reap.

A serious problem which all railroads are facing today is a shortage of section foremen. Why? Let me answer by asking, what have we sown? Seeds of intelligence? No, positively no. We have sown thorns of ignorance; and we are reaping thorns. Some will say that we are not doing so. But wait, do not speak without giving the subject a careful consideration.

The duties of a section foreman are hard and exacting and he has considerable mental worry; those who are ambitious feel when opportunities present themselves that promotions in the maintenance-of-way department should be theirs through meritorious service rendered. Should we not encourage it? Yes, but we are not doing so.

Nothing discourages a track-man more than to have a man placed over him whom he considers and knows is not deserving of the position; whose only recommendation is of a personal nature. He sees that his years of meritorious service amount to nothing; new men coming from other railroads are given the positions which are his by every right. Nothing but gross injustice is given him. Can we command his respect? Certainly not. We cannot expect it when we give to others that which he has rightfully earned.

Many men who were "bright lights" or "live wires" in track maintainence have left the track service to take up more congenial employment where they knew their services would be appreciated. What have we sown? What are we reaping? Nothing but thorns; in years gone by when a man became dissatisfied on account of unjust treatment, we would say, let him go, there are plenty of others. Today we are facing a famine on account of our inhumanity to man.

There is an old saying, "To the victor belongs the spoils." In the past victory was attained through physical strength; today it is a battle of brains. Therefore is it not reasonable to suppose that when a track-man has used his brains to make himself proficient for promotion that it belongs to him by right of conquest? By casting him aside and giving the position to some one else from the outside, whose only claim to it is letters of recommendation and personality, are we not committing a crime against our own people? Surely we are; we are cultivating thorns of dissension.

We have come to the parting of the ways; we have followed narrow-minded ideas too long; the time is ripe for a change. In fact it has been so for several years; the most radical and obstinate of us must admit that we must set aside our old methods and sow seeds of justice and intelligence. And as intelligence is demanded in all other walks of railroad life, so we must demand it in track-work; we must be considerate of the desires of our men, and our demands must be tempered with justice; while many in our employ are practically uneducated we must not forget that they can be educated.

Present day efficiency demands a two-fold training, actual practice combined with study. Education along practical lines means efficiency; railroads are demanding greater efficiency in track work every day, but are not helping trackmen to acquire it.

Some will say that track-men do not need technical education and point to themselves and say, "I did not get my knowledge by being taught," "I am a self-made man," "I

got mine through hard knocks." One moment, please. Were all the ideas you put in practice yours originally? Were not 99 out of every 100 of them brought to your mind through observation or told to you by someone engaged in similar emplyment? They surely were. Do not deceive yourself into believing that all you have learned originated in your own brain. Let us not forget that the wisest of us can always learn something from the humblest laborer. Many men today who are prominent in railroading, when a perplexing problem arises which they cannot solve, or they are not sure as to what their decision should be, will go to a man in a humbler position whose only education is practical experience, and have him give his opinion in the matter. While this man may not be able to express himself in terms such as are taught in technical schools, you can rest assured the "Official" will go away much more enlightened than he would have been had technical works been his only recourse. Therefore is it not a plausible theory that technic and practice would make more efficient track men?

As you can surmise, I am a strong advocate of technical education for trackmen, and I firmly believe the railroads are doing themselves and the track-men a gross injustice in not providing some method for instructing them.

We are sending our young men to colleges and universities to acquire a better education than we ourselves enjoy, but as I have expressed myself many times before we are educating the young men technically first, and in practice last, thereby fostering in him a distaste for manual labor, which is very essential to his success; without this his education is of no practical value.

While many may not think so, track work is a profession, just as much as law and medicine is. As the physician and surgeon attend us in sickness and accident, so does the track foreman attend the weaknesses and accidents of track; he is the track doctor, and in his profession he stands alone.

An efficient foreman is a well balanced man; when criticised as to his method of doing his work he can give good and sufficient reasons for using those methods. He is a student all his life, always studying to increase the output without increasing the cost. Is it not to the interest of the railroads to help him to attain greater efficiency? Efficiency is not the result of natural ability but of careful training; to make an efficient foreman we must not depend on his natural ability, but prepare him in advance by giving him the benefit of our years of experience and practice; today our track men must spend the greater portion of their lives learning the rudiments all through the school of hard experience, and many of them after long years of service are able to solve the problems of maintenance as they arise, but it has taken many years of service and practice to be able to do so. But if the railroads upon which their lives have been spent provided some method of instructing them technically at the same time they were receiving their practical training, many costly years of inefficiency would have been avoided and there is no question as to what would have resulted, in months instead of years; it is very evident that our present system is radically wrong. And we are reaping what we have sown.

Many argue that we must have graduates of engineering schools to supervise maintainence of way; I believe their opinions are erroneous.

Let me cite a few admissions made by college professors, consulting engineers and others employing technical graduates. One professor in one of our universities, who made it a practice to gather data on the subject, admits that five years after graduation, over 50 per cent of engineering graduates are not successful; yet he asserts that the graduates rise rapidly to positions of responsibility. If the professor was inclined to be candid I believe he would admit that the rapid rise was due to some influence; political, parental or financial. He further states an apprenticeship of one to two years immediately after graduation has proven itself a sure road to eminent success in later years. He advocates a "sheepskin" first, practical knowledge last; this is wrong; he is building the structure first and the foundation last.

An eminent consulting engineer who has charge of a large amount of practical engineering work, freely admits that new graduates are worth less than nothing; and advises them to take subordinate positions under practical men, thereby supplementing their technical knowledge with a practical education.

Other eminent engineers assert the ultimate value of an engineering school education only is realized when it is supplemented by practical experience in the shop, field or office, either before or immediately after graduation.

Almost without exception it is the man who had to earn in practice the funds necessary to obtain his education that is the successful engineer.

The largest field of labor today is the railroad field, and as our track labor is inefficient on account of increasing demands made upon us, we must discard our present system of using uneducated foremen and labor and start a campaign of education among our track men. Some ask in what manner, using technical graduates? No. They have proven themselves failures; the seeds were sown on stony ground and planters and tillers acknowledge the best they can do is to raise a half a crop after nine years of toil (four years in school and five years out in the world). We also know that practice without technic is a stony road to travel. Therefore, there is but one fertile course open to us, and that is to combine practice with study.

Let us assume that every position in the maintainence of our railroads belongs to our employees, from laborer to chief engineer; and that no outsiders need apply except to take a position at the bottom of the ladder and climb up on merit and that it must be on competitive examination; make each laborer pass a certain number of points before taking the first step upward and prepare himself for the next step by practice and study, impressing upon him that his success depends upon his endeavors in acquirng the knowledge to guarantee his promotions; by doing so, instead of reaping less than half a crop on stony ground after many years of toil, we will reap an abundant crop from fertile soil.

It is absolutely true; as we sow, so shall we reap.

A section of the Great Northern between Bedford, N. Dak., and Surrey, 185 miles, has been opened for business.

The Illinois Central has awarded a contract to Bates & Rogers Construction Co., Chicago, for concrete work on track elevation at Memphis, Tenn., involving the construction of six subways and about 25,000 cu. yds. of concrete.

The Lexington & Eastern has opened a new line called the Eastern division from Jackson Ky., east to Whitesburg, 86.4 miles.

INEXPERIENCED FOREMEN.

Wm. Christensen.

Referring to the labor problem the trouble lays with the foreman in charge. Most track foremen today are young men that have been working in one place for a long time and have been made foremen because they are steady. Such a man will be given a gang and ten chances to one he gets the swelled head. He is put with a bunch of men that follow track work; they go from section to section, and learn different and easier ways of doing work than the foreman knows. The men get disgusted with him and will not stay.

We work Mexicans here and pay $1.00 for 10 hours' work, and Mexicans if handled right will put in 70 to 80 ties a day in dirt track, or 60 ties in ballast track.

The Southern Pacific has a training school here to train

foremen. They keep a man in the training gang two years and then give him a section. When he has served his time out they send him to a different section where conditions are different than they were where he came from. And he is just like a chicken with its head cut off; he does not know what to do; he does not know enough about handling men to let them go ahead and do a job. If they don't do a job like he was taught to do it, he thinks it is wrong, and of course he is boss and has his own way.

The Mexican Eagle Oil Co. is said to have awarded a contract to John Monahan of Tampico, Mex., to build a Railway from La Pena to Portrero del Llano. It is said that the grading work has been started and that track laying will be started within 60 days.

It is reported that the New York Central Lines have completed plans for the construction of large freight interchange yards at Gary, Ind., extending from West Gary to Gibson. Actual construction work will be started in the spring.

The North Railway, it is reported, is making surveys to build from Montreal, Que., to James Bay, 530 miles.

The Chicago, Milwaukee & Puget Sound it is said, is considering the erection of a freight and passenger station at Bremerton, Wash.

The El Paso & Southwestern, it is reported, has awarded a contract for a new passenger station at Douglas, Ariz.

The Evansville, Henderson & Owensboro, it is said, will build a drawbridge over the Green river at Hambleton's Ferry, Ky.

With The Manufacturers

New Literature

The Chain Belt Co., of Milwaukee, has recently started publishing "Chain Belt" which appears monthly. This publication is devoted mainly to concrete. Not only is the mixing of concrete featured, but the different issues contain live matter with respect to proper proportioning of aggregates, economical methods of placing and suggestions of a practical nature. The humorous side is not neglected, an illustration of this feature being the Concrete Inspector in the November issue.

DUPREE TANK HOOP.

The Dupree tank hoop, illustrated herewith, was designed by a man who has built a good many water tanks of fifty and one hundred thousand gallons capacity, but who was dissatisfied with the styles of the hoops in use.

Flat hoops are thin and wide; their thinness allows corrosion to eat them out quickly; their width is objectionable for the reason that they cover too large an area of wood. Also, on account of the tubs (in most cases) being smaller at the top than at the bottom, wide hoops do not fit as tight along the top as at the bottom edge, hence there is more or less of the space for small particles of cinders and dirt to collect back of the hoop, and when moisture and gases from engines combine with the cinders and soot, corrosion is hastened, especially if the hoop is made of steel.

Round hoops are considered objectionable by many for the reason that they have such a small bearing surface on the wood that the fiber is crushed; this crushing is most serious with the softer varieties of wood. Round hoops also leave considerable space on the upper side for catching and maintaining water, cinders, etc.; this condition is even worse with a round than with a flat hoop.

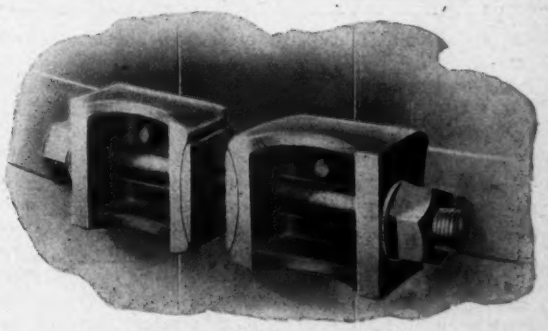
Dupree segmental hoops are 3 ins. wide, ½ in. thick, and have sharp edges which, when drawing up, fit snugly to the wood. They have a flat surface for the bearing on the staves, and are thick enough so that they can stand the loss of considerable of their section (by rusting away) and still have body enough so that they will not break.

Segmental or half round hoops combine the advantages of round and flat hoops without the disadvantages. They do not cut the wood, or leave a projection to accumulate dirt as do round hoops. The round exterior gives greater thickness, strength and consequently wear than the flat hoop.

An ingenious lug is used with the Dupree hoop of special design. It has the following advantages: (1) There are no sharp corners to gouge the wood when hoop is being tightened. (2) The rivets are relieved of part of the strain by the hoop being bent around the castings.

The Dupree tank hoop was designed and patented by James Dupree, water service foreman of the Chicago, Terre Haute & Southeastern. It is being marketed by T. W. Snow & Co., Ellsworth Bldg., Chicago.

Comparison of Different Types of Tank Hoops.



Dupree Tank Hoop Lug.

MANUFACTURE OF RAILWAY SHOVELS.

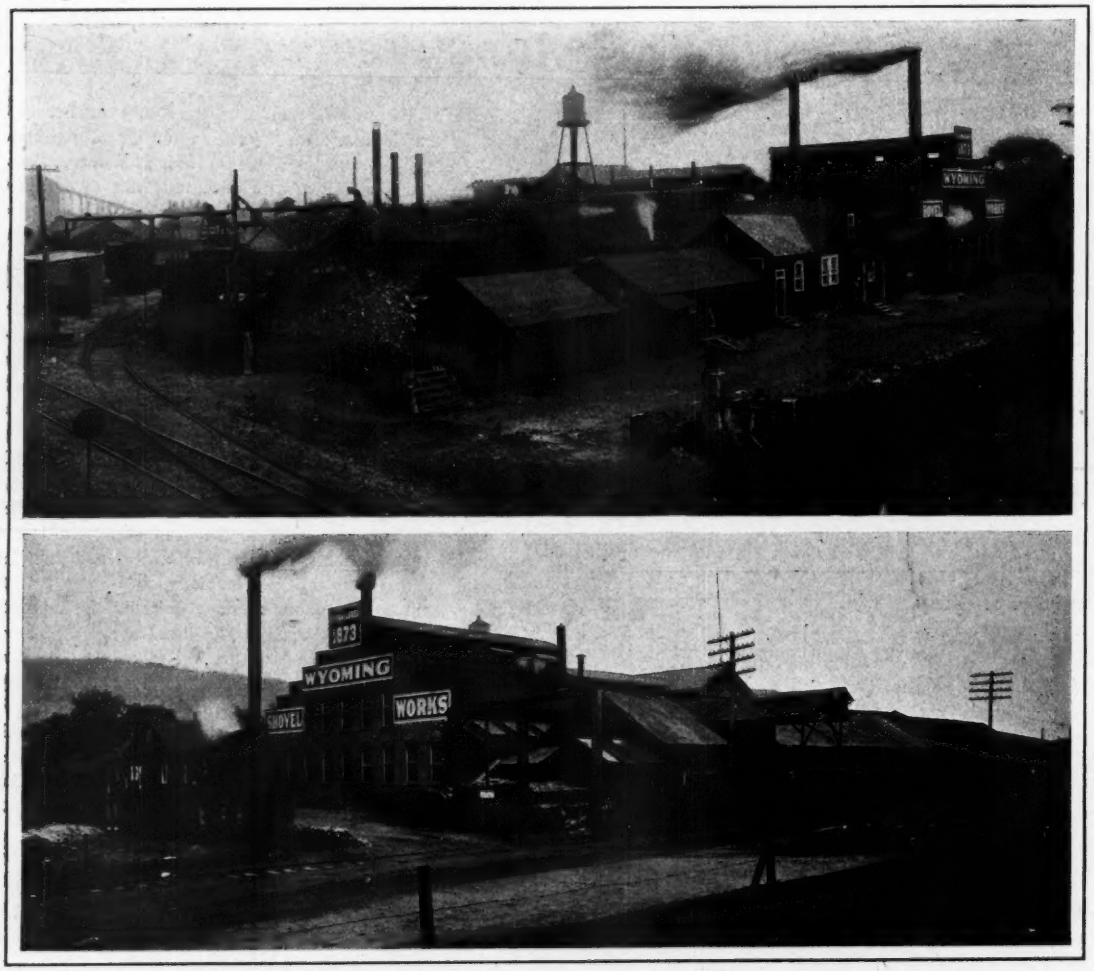
To the ordinary buyer of a shovel or spade a shovel is just a plain shovel, nothing more, and is expected to do the work intended whether designed for the particular purpose or not. Even the more intelligent buytr, who understands something about what quality in a shovel means, gives little thought to its manufacture, what spring, hang and general construction bear to the performance of the work, thai is, greatest efficiency at the lowest labor cost, as well as exertion on the ptrt of the user.

To the skilled artisan a shovel with the proper spring, hand and bend of handle, fits into a groove just as does the carpenter's favorite saw, or the mechanic's favorite wrench.

On large work, such as contracting, the quality of the material of which the shovel is made is an important factor. The constant wear on the shovel soon reduces its value as an efficient tool. A wear of 10 per cent on the blade means a reduction of at least 10 per cent in the day's work. At such a rate it is obvious that the original cost of the shovel is lost in a few days, and the loss goes on, and, as a rule, the cheaper the grade of shovel, the greater the loss.

Four Grades of Quality.

Little thought is usually given by the purchaser to the multiplicity of operations, care, selection of materials and proper working of them, that confronts the manufacturer of a shovel. The ordinary user is inclined to consider this tool simply as a piece of steel affixed to a handle, just intended to dig with. In the inferior grades this definition might apply. A manufacturer classes shovels under four grades: Excellent, very good, good and only fair, which, in a large measure, classifies the tool in accordance with price, and the low priced shovel, like any other tool or machine, is usually classed among the "only fair" as far as efficiency and wear are concerned.



North and South Views of Wyoming Shovel Works, Lehigh Valley Siding on North, D. L. & W. Siding on South.

Shovel Design.

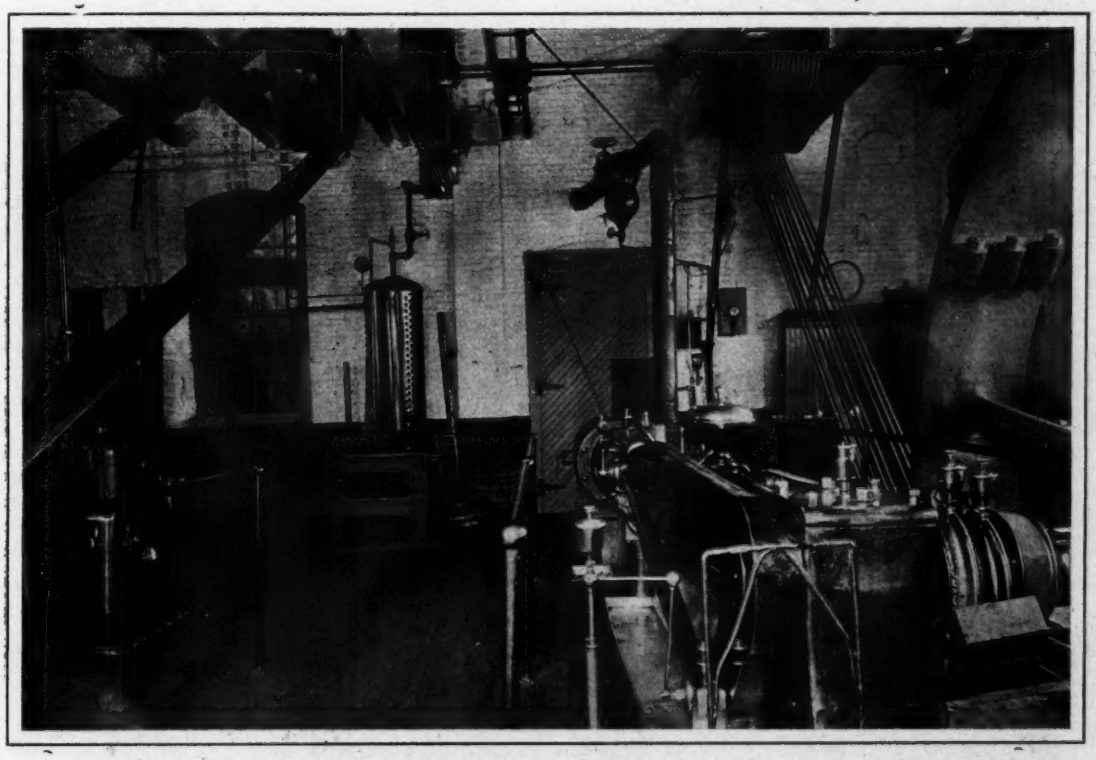
In the purchase of shovels for a specific class of work design as well as quality play an important part. Under the present day methods of labor saving economy engineers have demonstrated that the adoption of shovels of different design for different classes of work has proved successful and that the purchase of a larger number and variety of shovels, where labor is engaged on different classes of work and shovels furnished employees adapted for the work intended, has proved economical and enabled the volume of work to be increased without unnecessary exertion on the part of the user.

Wyoming Shovel Factory.

The plant of the Wyoming Shovel Works, Wyoming, Pa., is located in the Wyoming Valley, in the northern part of Pennsylvania. The establishment of the Wyoming Shovel

Works was operated in 1873 by Fayne, Pettebone & Co., and was incorporated as the Wyoming Shovel Works in 1893. At that time the plant occupied a ground space of approximately 100 feet square, and had a capacity of about 3,000 dozen shovels of various types per year, all of which had to be carted by wagon to the railway, as well as the supplies from the railway.

Now switches of the Delaware, Lackawanna & Western, and the Lehigh Valley Railroads enter on either side into the plant. The works cover 3½ acres, and the annual output has mounted to over 50,000 dozen shovels, spades and scoops of various types, while the rolling mill department is a large producer for the market of steel sheets, for springs, knives, discs, automobile frames, etc. Also practically the entire requirements of D and long handles is supplies by the company's own handle plant.



Shop Engine, Dynamo and Compressor.

The crude steel from which the shovels are made is received in the form of slabs or billets, approximately 2 in. thick, and from 10 to 12 in. wide, produced by either the open hearth or crucible steel process, the best grades being made by the latter. These are unloaded from the cars by steel magnets, attached to an electric crane. Much care is given the storing in stock of these pieces of steel, which comprise the raw material of the shovel maker.

The composition of each shipment is definitely known, chemical analysis and physical tests are made and each grade of material, particularly in view of its hardness, is carefully piled and marked for future use. Hundreds of tons of crude steel are continually kept in stock.

Initial Process.

The first process in the making of a shovel is the rolling of the steel into sheets of proper width and thickness for the class of shovel for which it is to be used. Frequently it is necessary first to cut the billets or slabs to definite size predetermined by weight, when intended for special work. The billet is then placed in a heating furnace and the temperature raised to the point necessary for rolling, usually a dull yellow. Various passes through the rolls, give the resulting sheet the proper size and smoothness of surface.

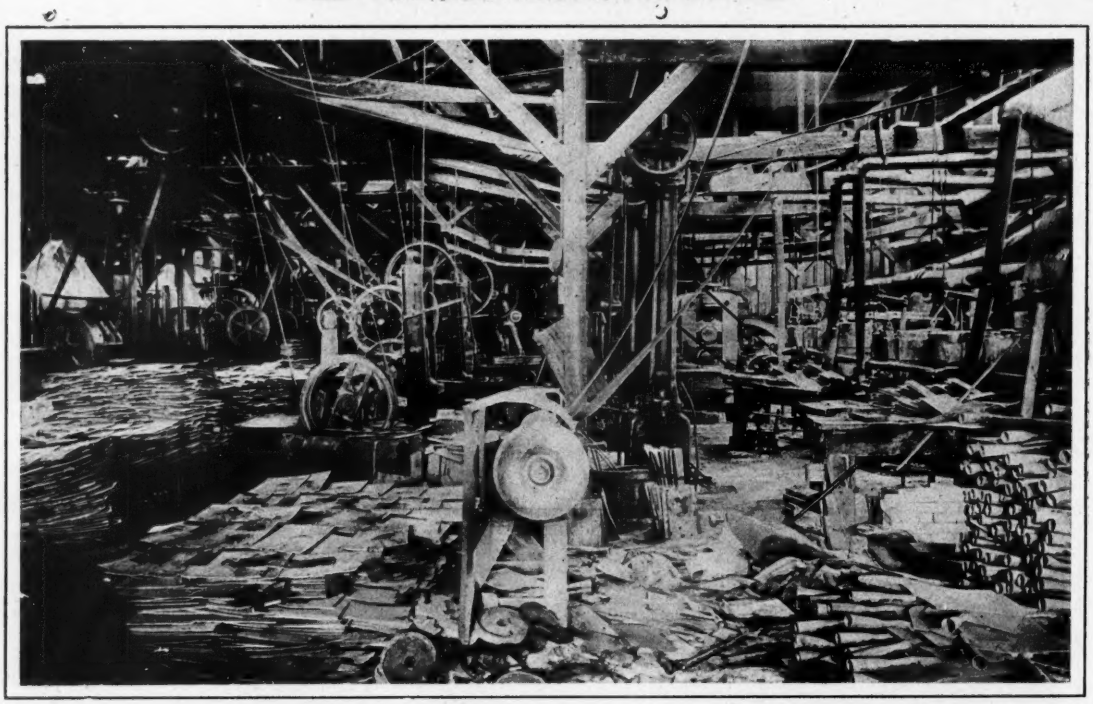
In thickness the sheets vary from No. 8 to No. 16 Brown & Sharpe gauge, and they are about 9 ft. long. The sheets then go through annealing furnaces, and after cooling are trimmed and squared. An electrically driven shear, having a cutting blade of 126 in. is used for this part of the operation. The sheets are then weighed and stored, to be used as required. The waste coming from the shearing of the sheets is used for making plate washers, while the material too small for this this purpose is sold for scrap.

Forging Dieing and Pressing.

The forging, dieing and pressing of the rough blanks comprise a multiplicity of operations. In the forging department front and back straps, solid shanks, according to the style of the shovel or spade, are welded or riveted to the square blank. The front and back straps are separately welded on, power driven dead stroke hammers being used for this work. The blanks are then cleaned with rotary power driven wire brushes to remove scale resulting from the heating and forging operations, after which each is inspected for perfect welds. Any defect in the welding operation causes the blank to be rejected.

After this inspection the blanks are trimmed to size on presses, using solid dies for cutting them to the shape desired. The banks, or blades, are then taken to the pressing department, where, after heating to a dull cherry red heat, the blanks are pressed into the shape of a finished shovel blade. Several hundred master dies and forms are required for the purpose of cutting and pressing the many sizes and variety of shovels made.

Many classes of shovel blanks require further treatment before they reach the stage of a finished shovel blade. The edges are forged to take out any crimps in the metal. Hollow back scoops, however, do not require the extensive

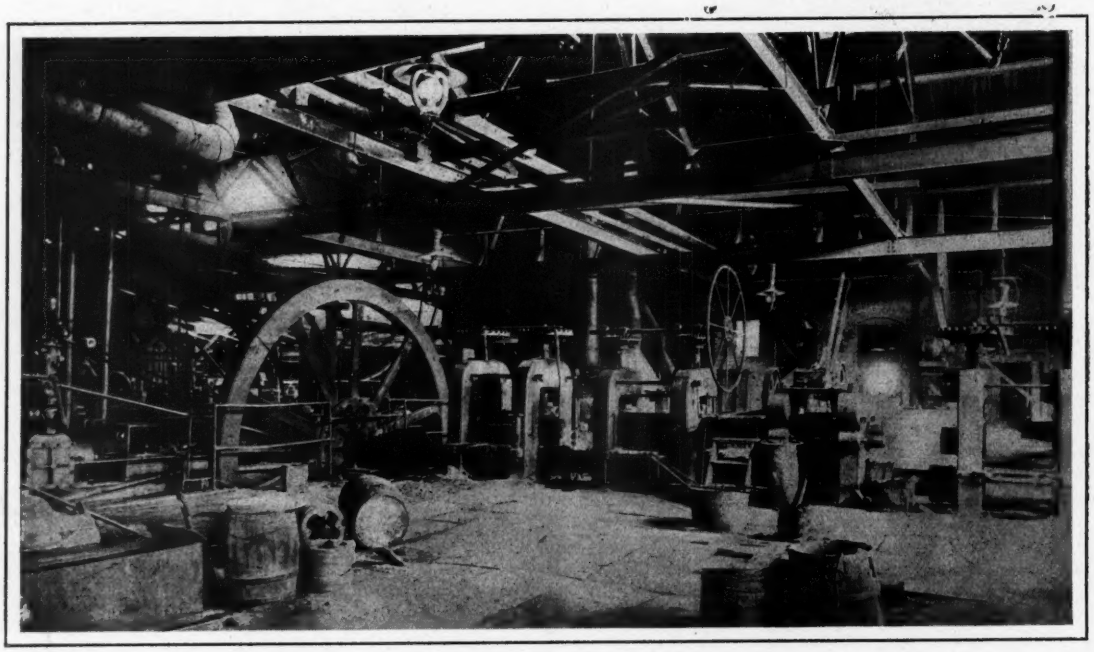


Section of Forge Room. Steel in Process of Formation into Blades.

operations used in making forged or riveted back shovels. being pressed in one operation from the original trimmed blank. In other grades the shanks are welded on by electricity.

All the blanks go through a trueing process to make them uniform in shape. All blades for polished work after being immersed in acid, to remove scale, are ground and polished on emery buffing wheels. Shovels are all edged before finishing. This part of the process in making hollow back scoops follows after the handle has been adjusted, the handle being forced into the socket by pressure and then riveted in place. Following the trueing process the shovels are again inspected and are then ready for cleaning and grinding.

The grinding and polishing process varies according to the grade of shovel. After the polishing is completed the shovel blades are dipped in oil to prevent rusting, and the straps stenciled according to brand, size and grade, and the blade is then ready to be assembled with the handles.

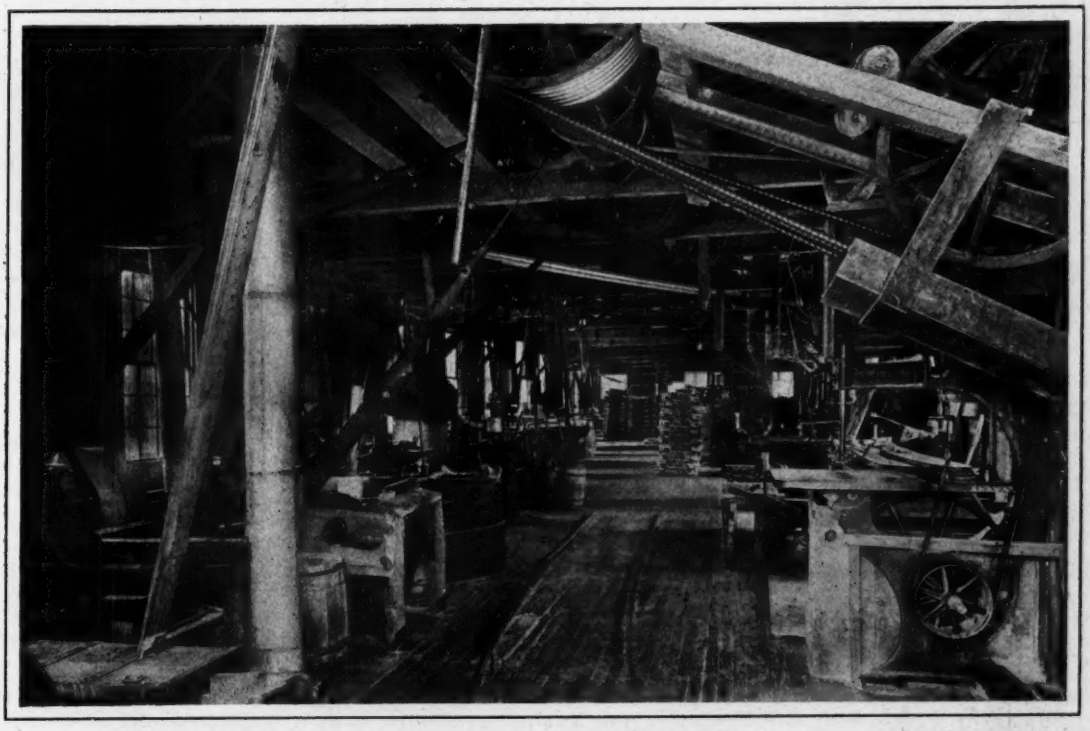


Rolling Mill; Forge Room to Left; Shear Room Beyond Roll Train.

Handles.

Handle making is an important branch of the shovel-making industry. At Wyoming second growth northern ash is used exclusively in the manufacture of the handles. The crude lumber comes to the plant in logs. The logs are sawed into slabs 1¼ in. thick. In making the D handles, a handle templet of desired size is laid out on the slab, care being taken to avoid knots and other imperfections. The blanks are ripped out with a band saw, cut by equalizing saws to exact length, then placing in lathes, which round the stem of the handles. A jointer and backer machine dresses the D front and back, while several follow to smooth and trim the handle to a finished condition.

After an inspection to insure perfect work, the handles are graded, weight, whiteness of color, freedom from knots and other conditions being factors in the selection as to grades. The handles are then placed in storage for months. They are then ready to be shaped for either shovels, spades or scoops.



Handle Plant, "D" Handle Machines on Left, Long Handle Machines on Right.

The D handle portions are bored and riveted to strengthen and prevent checking. The finished handles are given the desired bends, by having their ends steamed, placed in bending machines, which force the handles into cast iron forms of the desired shape in which they are permitted to remain during the process of drying, after which the handles are placed in stock where they are maintained for further seasoning, being delivered to the finishing departments as required.

The making of hammer and other special handles for the trade involves the use of short lengths, as well as that of rejected shovel handles, parts of which are still adaptable for use in the smaller handles for various uses outside the shovel industry.

Finishing.

The assembling of the handle and blade, or what is termed the finishing of a shovel, is an important operation. In this department the work is done by experienced workmen and involves a number of operations. In riveted or welded shank work the front and back traps are first opened to admit of the handle. The handle is then forced into the shank, the handle being held in a vise and the blade driven on the handle. It is then drilled to admit of rivets, and the operation of riveting the straps to the handle follows.

The straps are rolled to conform to the shape of the handle, and the shovel is then ready for the buffing and belting room, where the straps are buffed on large emery wheels, and the handles cleaned and smoothed on rapidly running sand belts, after which they go to the varnish room where they are dipped in varnish and allowed to stand on racks to dry. Then the blades are affixed and the shovels are ready for binding, half dozen to each bundle, and are shipped or go into stock as required.

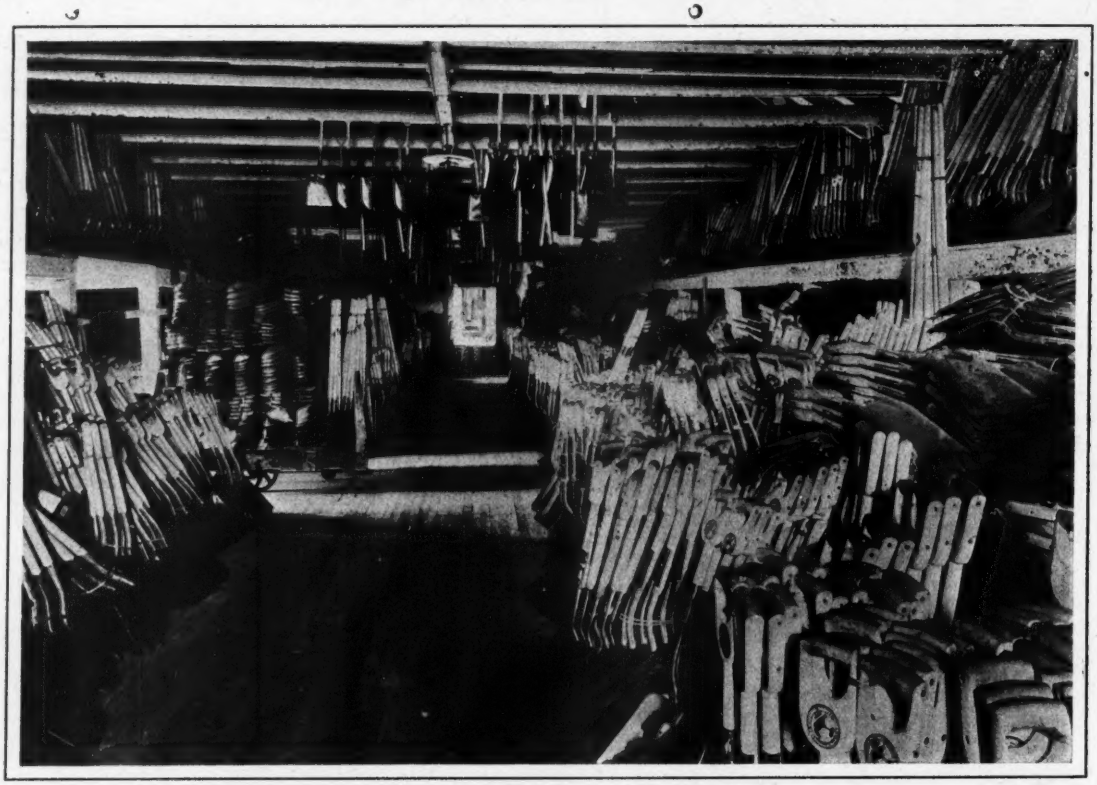
Storage.

In the stock room the shovels are stored in bins, a careful accounting being made and quantity on hand constantly checked up. Each class, size, grade and style of shovel, spade, scoop or special style in maintained in separate bins and the magnitude of the space required may be judged from the fact that hundreds of different styles, grades and sizes are carried in stock, in which are included shovels of different lifts, weights, gauge and finish, varied handle styles, length of straps (which vary from 9 to 30 in. long) and many special features too numerous to mention.

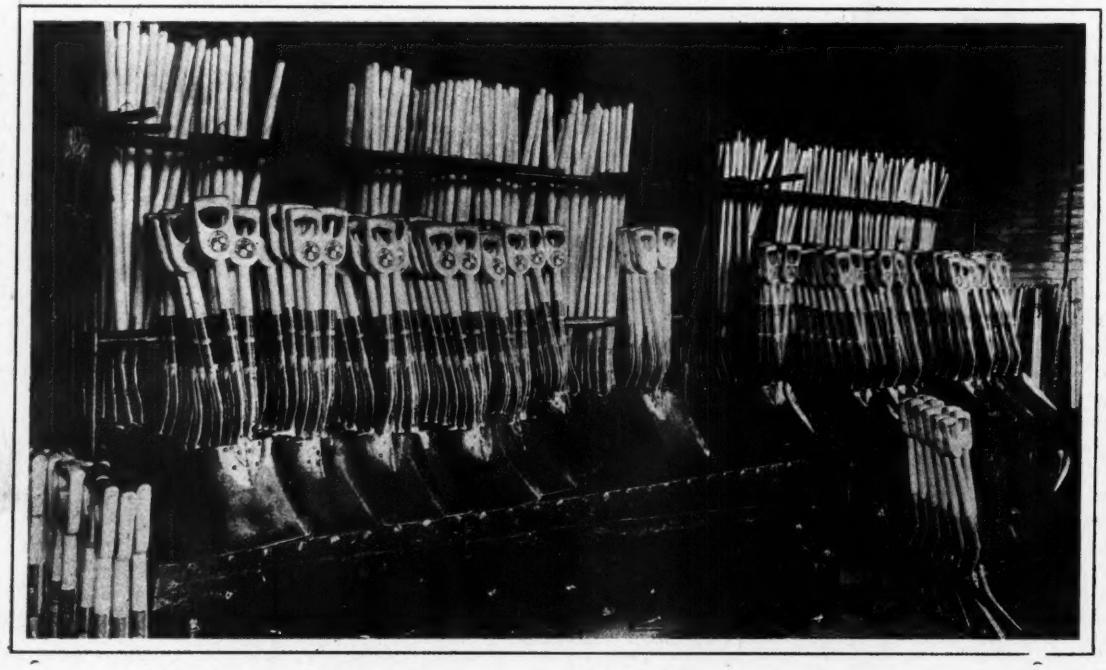
Preparation for shipping involves considerable attention, bundling or burlap covering and casing for export being necessary in order to preserve cleanliness and good order on delivery.

System of Records.

The large variety of work and multiplicity of operation require an up-to-date, accurate system of checking in order



Warsroom; Shovels Ready for Shipment.



Finished Shovels Ready for Shipment.

to trace work through the plant, as well as to obtain records as to stock, shipments and orders. An in and out checking system, closed daily, enables an accurate stock record of finished goods to be kept. A record of each order is retained, duplicate being sent the customer, which serves as an acknowledgment of the order. A triplicate of this record serves as a shipping order, but on this no notation as to price appears. An order on the forging department covers each individual lot of work, a duplicate being furnished to the shipping room.

Forms covering different orders are also issued for the backing and polishing departments. On all department orders dates for the completion of the work are supplied and the return of the blank to the office, properly filled out and signed, indicates the completion of the order in each department, and covers a complete record of the work performed in the different departments of manufacture.

The Wyoming Shovel Works makes a complete line of quality shovels, covering every class of shovels, spades and scoops and special types. The most important line, however, is the Pettebone standard shovel and scoop, in which the back strap is so fixed that the rivets are below the line of wear, thus insuring straps that will not work loose.

In smooth back shovels, the Robertson, Scranton and Nileb are among the important brands, as in mining shovels is the Gold Nugget, and in Maynard pattern solid shank shovels, the Capitol, all of these brands being protected by copyright.—*Iron Age Hardware.*

Industrial Notes

The Tinsley Railway Supplies & Equipment Co., 1022 Mc Cormick Bldg. Chicago has taken over the business of the Chicago Car Specialty Co., including the Rausch pouch rack. This device for the carrying of open pouches in mail cars is designed to meet the conditions imposed by the rules of the Railway Mail Service Committee.

The American Steel Cross Arm Co. has recently been granted a Pennsylvania charter. The new corporation, which is capitalized at $300,000, has its headquarters in Pittsburgh, Pa. It will specialize on steel cross arms for railway and telegraph service. H. G. McCutcheon and W. H. Anchor, of Pittsburgh, are named as incorporators.

The L. M. Booth Co. has moved from 136 Liberty street, New York to 22 Morris street, Jersey City, N. J., where it will have greatly enlarged space.

The Gulf, Colorado & Santa Fe is reported to be planning to erect a new general office building and to enlarge its division terminal at Amarillo, Tex. This company will also build a storehouse and make other improvements to its property at Somerville, Tex.

The Kettle Valley is said to have plans prepared for the construction of a bridge across the Fraser river at Hope, B. C. The estimated cost of the work is about $800,000.

The Louisville & Nashville will build 3 large bridges on its Athol and Winchester, Ky., line. This company is also asking bids for improvements on its Montgomery, Ala., station at an estimated cost of about $25,000.

The Missouri, Kansas & Texas it is reported will start work within 90 days on the new $300,000 passenger station. The same road has asked bids for the construction of a new passenger station to cost approximately $40,000.

Mojeski & Angier, inspecting civil engineers, Chicago, Ill., have opened a branch office at 1601 Chemical Bldg., St. Louis, Mo., in charge of W. F. Randolph.

The exhibit of the National Railway Appliances Association, to be held in connection with the convention of the American Railway Engineering Association, at Chicago, March 18-20, will again be held in the Coliseum and the first Regiment Armory. Exhibitors can begin installing their exhibits on March 12, and the exhibition will be open from March 15 to March 21, inclusive, with the exception of Sunday, March 16. Substantially the same rules and regulations governing the exhibition of 1912 have been adopted for the exhibition of 1913.

The Northey-Simmen Signal Co., Ltd., of Toronto, Ont., has been incorporated in Canada to manufacture signaling appliances and equipment for railways and navigation. Capital stock, $5,200,000. The directors are, J. N. Northey, Thomas A. Plummer and Thomas P. Wadsworth.

The Isthmian Canal Commission will receive bids until December 2 on miscellaneous supplies, including switches, switch stands, galvanized steel or iron, sheet brass, bronze bars, babbitt metal, etc. Circular No. 745.

Hiram J. Slifer.

Hiram J. Slifer announces the opening of offices as consulting civil engineer, specializing in steam railway practice, at 925-27, 209 South La Salle Street, Chicago, Illinois. Mr. Slifer is a member of the following associations: American Society of Civil Engineers; American Railway Engineering Association, American Institute Consulting Engineers, Western Society of Engineers.

Mr. Slifer was from 1878 to 1898, a civil engineer, of reconnoissance, location, construction, improvement and maintenance on the Mexican National Construction Co., the Pennsylvania Railroad Co., and the Chicago & North-Western Railway Co. From 1898 to 1905 he was an operating officer on the Chicago & North-Western Railway and the Chicago, Rock Island & Pacific Railway. From 1905 to 1907 he was in special work as a steam railway expert, making examinations and reports and as construction manager on steam railroad properties for J. G. White & Company, New York.

He then became assistant to president, and general manager of the Panama Railroad and Steamship Lines, Isthmus of Panama, which position he held until 1909 when he became general manager of the Chicago Great Western R. R. He has only recently left the latter road to take up his new work.

Mr. Slifer's large acquaintance and his unusual experience should bring him success in his new work.

Recent Engineering and Maintenance of Way Patents

CONCRETE MIXER.

1,045,117—Edward F. Bolte, Chicago.

In a device of the kind described, a rotary drum provided on its inner surface with spirally arranged cables attached thereto at different points longitudinally of the drum, and with sufficient slack between points of attachment to permit the engagement of the intermediate portions thereof with the shell of the drum, the cables serving as lifting flights and scraping the inner surface of the drum.

RAILWAY SAFETY APPLIANCE.

1,045,188—N. J. Roether, Mineral Point, Wis.

A railway safety appliance comprising pairs of opposed clamping members having rail base engaging fingers for engagement against the upper and lower faces of the bases of opposite rails of a track, means for connecting the pairs of clamping members, and rectangular anchoring plates secured upon opposite sides of each pair of clamping members, the corners of each anchoring plate being bent on a diagonal line and at right angles to the plate.

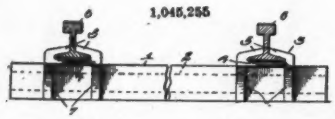
1,045,255—J. H. Capps, Tolbert, Tex.

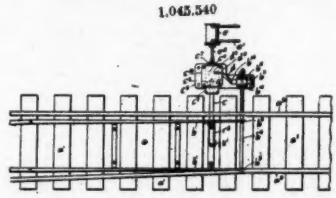
A compromise rail joint including the dissimilar rails, opposite tangular tie having a chair formed integral adjacent each end thereof, the chairs each comprising a base, inwardly extending flanges formed integral with the base and arranged in spaced relation therefrom, and brace members disposed at each end of the chairs and arranged in pairs upon each side of the tie.

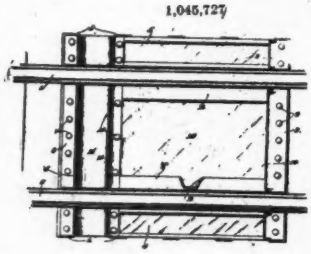
RAIL JOINT.

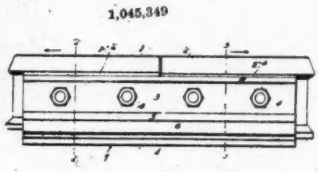
1,045,349—Benjamin Wolhaupter, Rochelle, N. Y., assignor to the Rail Joint Co.

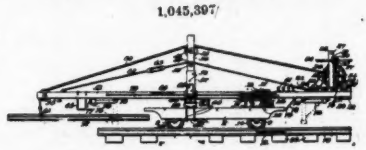
A compromise rail joint including the dissimilar rails, opposite joint bars having a uniform cross-section throughout their length,











and filler members fitted between each of the rails and the joint bars, each of the filler members also having a uniform cross-section throughout its length.

COMPROMISE RAIL JOINT.

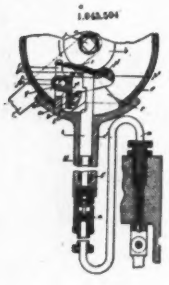
1,045,350—Benjamin Wolhaupter, Rochelle, N. Y., assigner to the Rail Joint Co.

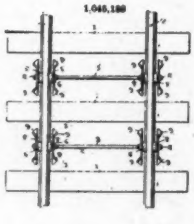
A step rail joint including dissimilar rails, opposite angle bars having a uniform cross section throughout, and filler members interposed between the angle bars and the rails and fitting the fishing spaces at both sides of each rail end.

TRACK LAYING MACHINE.

1,045,397—L. Gudgell, Galesburg, Ill.

In combination with a car, a boom pivotally mounted approximately at its midlength thereon, substantially parallel with the floor thereof, and adapted to reciprocate but not to rotate, an antifriction bearing supported on the car, means supported by and adapted to traverse the bearing for supporting one end portion of the boom, a windlass supported above the boom and disposed near one end thereof, a cable operable by the windlass and extending to the distant end of the boom, and rail tongs carried by the free end of the cable.





AUTOMATIC SIGNALING DEVICE.

1,045,504—J. P. DeBraam, Paris, France.

This device comprises a shaft for controlling the train mechanism, a spring tending to rotate the shaft, a disk secured to the shaft and provided with a projection, means normally engaging the projection to hold the disk and the shaft against rotation, movable means adapted to be actuated to render the holding means inoperative, whereby the shaft and the disk will be rotated by the spring, a pawl normally in the path of the projection and adapted to be engaged thereby, whereby rotation of the disk and the shaft is arrested, and means co-operating with the aforesaid parts for rendering the pawl inoperative upon a second actuation of the first mentioned means, whereby the shaft and the disk will be further rotated by the spring.

SWITCH LOCK.

1,045,540—S. D. Frank, Media, Pa.

The combination with stationary rails and movable switch rails, of a locking mechanism consisting of a slidable lever-arm in movable connection at one extremity with the switch rails and at the opposite extremity having a roller-pivot, a fixed plate and a movable plate, each having a cam-slot, the plates being in engagement with the pivot and each having a shouldered portion, said rollerpivot arranged to engage and travel in the slotted portions of the cam-plates and to contact periodically with the shouldered portions of the plates, a slide-rod arranged to engage the switch rails and provided with grooves, a locking-bar provided with lugs for engaging the grooves of the rod, a bell-crank lever having two slotted arms, one arranged in connection with the locking-bar and the other to engage the pin of the movable one of the slotted plates.

HOLLOW CONCRETE TIE.

1,045,711—H. L. Leonard, Wayne, Pa.

A railroad tie having a surface adapted to support a rail and comprising a hollow reinforced concrete body, the outer portions of the body near the outer surface thereof being of greater density than the inner portions thereof whereby the tie is not liable to injury from the rail bearing and the tamping of the ballast, and the concrete body having additional reinforcements surrounding the hollow ends to prevent injury to the tie from the lifting jacks.

CATTLE GUARD.

1,045,727—James Mohr and Sylvia Mattox, Wilson Creek, Wash.

A surface guard comprising a frame embodying an inclined body portion having one of its ends formed with a substantially straight foot, the opposite end of the body being provided with downwardly curved extension which also terminates in a substantially straight foot, the longitudinal edges of the foot being provided wtih vertically extending flanges having right angular offset inwardly turned portions, the flanges terminating a distance away from the first named foot of the body, a plate adapted to be engaged between the flanges and the angular inturned portions thereof, the plate adapted to abut with the first named straight foot of the body, the body being further provided with a removable transversely arranged head which contacts with the flanged portion of the body and also with the plate received within the body.

The Balimore & Ohio is reported to have recently lost by fire, a signal tower at Farmington, W. Va.

The Canadian Northern Ontario, it is reported, has been given authority to build bridges across St. Lawrence boulevard and across St. Denis boulevard at Montreal, Que.

The Central of Georgia will soon award the contract for the construction of the passenger station at Barnesville, Ga. at an estimated cost of $20,000.

According to press reports, the Central New England has started work on a new one-story brick freight shed 37x315 ft., at Hartford, Conn. An addition to the present office building 30x28 ft. is also being put up.

New Dixon Railroad Booklet

We have just prepared a booklet treating of the various Dixon graphite products for use on the railroad. The entire Dixon railroad line is treated of and all other matters excluded—this booklet is of interest only to the various mechanical railroad departments.

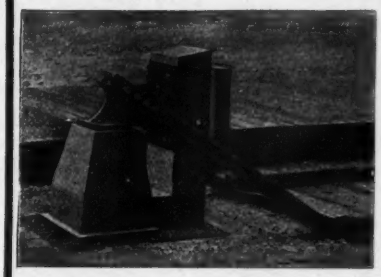
The application of dry graphite for lubrication, the use of Dixon's graphite greases, Dixon's Silica-Graphite Paint, crucibles, facings, crayons, etc., is all included in this booklet—a total of 40 pages. There is bound to be some matter to interest you here.

We have tried to make our booklet attractive in appearance as well as interesting to read, and to this end have included views taken of railroad stations and yards, stretches of track, signals, bridges, etc.

Write for copy of this booklet by number 187 R. R.

Joseph Dixon Crucible Co.

Jersey City, N. J.



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350 pages; fully illustrated, 5¼x7½ inches. Price, $1.50, net postpaid.

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By D. H. LOVELL
Division Superintendent Pennsylvania Ry.

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This book is presented in a very clear manner, which is at once simple, thorough and practical.

The contents include chapters on General Turn-outs; Stub and Split Switches; Analysis of Curves; and a large number of tables for the quick and correct construction of any switch.

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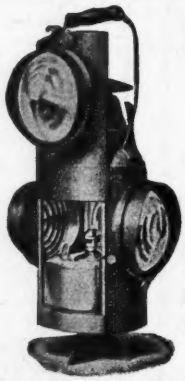

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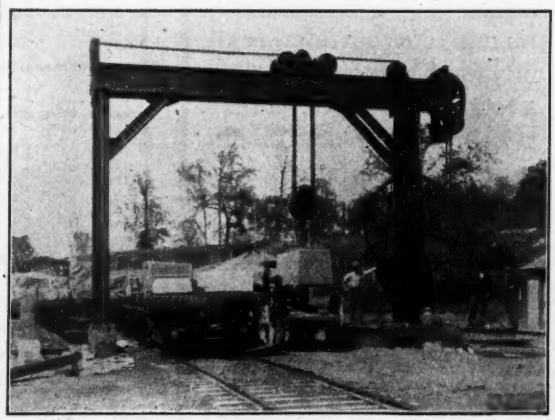

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is an inexpensive and durable machine for handling all heavy loads from car or wagon with just one or two men. Being equipped with safety appliances, it practically eliminates all danger to the men.

Write for our new catalog J on bridge cranes.

THE BROWN HOISTING MACHINERY CO.
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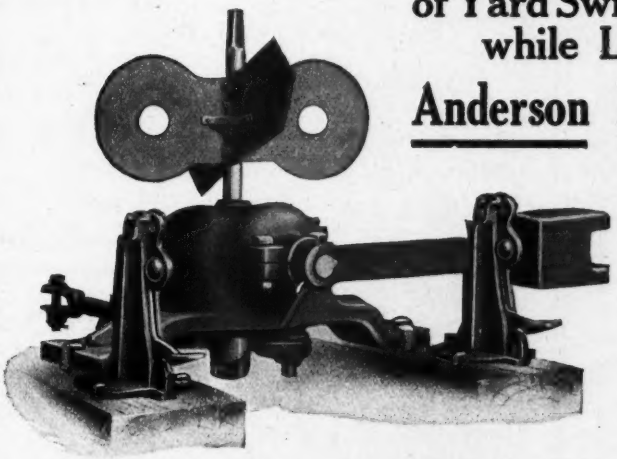
$16\frac{2}{3}$ CENTS Maximum Maintenance Cost

of Yard Switches that are Run Through while Latched if you use the

Anderson Economy Switch Stand



This stand for yard switches, is provided with a special 3 way crank arm made of malleable iron. This 3 way crank arm is designed that when switch is run through, one of the arms to which the switch is connected will shear off, without damage, to any part of the switch mechanism.

The switch can be quickly placed in order by connecting the rod to one of the other arms. When the three arms are destroyed a new three way crank can be applied. These are furnished at 50 cents each. This feature is not new.

Over 30,000 Economy switch stands with this special 3 way crank, in service on many railroads.

Nonbreakable cranks are furnished for main line switches.

Full Details and Description of This Switch Stand in Our Catalogue. Write for It

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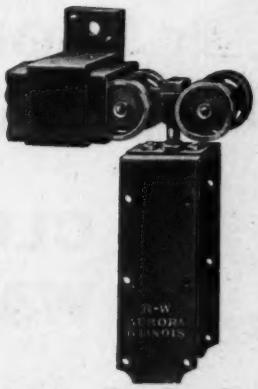

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Over one-third more cars moved and 1600 tons less coal consumed in doing it should appeal forcibly to every railroad man whose locomotives traverse bad water districts.

Write us for a copy of the railroad report upon which the above statement is based.

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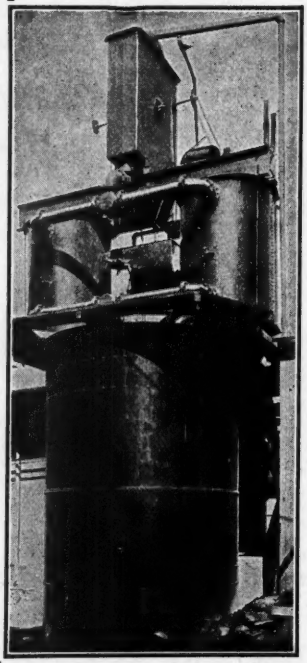

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Every locomotive water supply station—getting its water from a different source—is a separate water purifying problem for the railroad man.

Foaming troubles are a universal complaint, and it is only by our unusually long experience of 50 years in the water purifying business and a special study of conditions in alkaline water districts that

LORD'S WATER PURIFYING CHEMICALS

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They completely remove any existing scale and prevent its formation.

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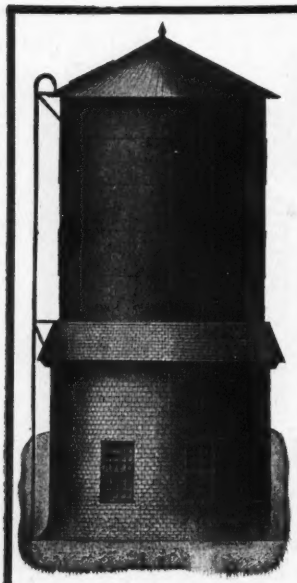

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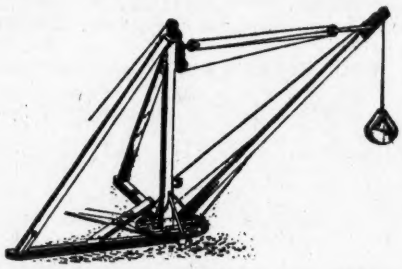

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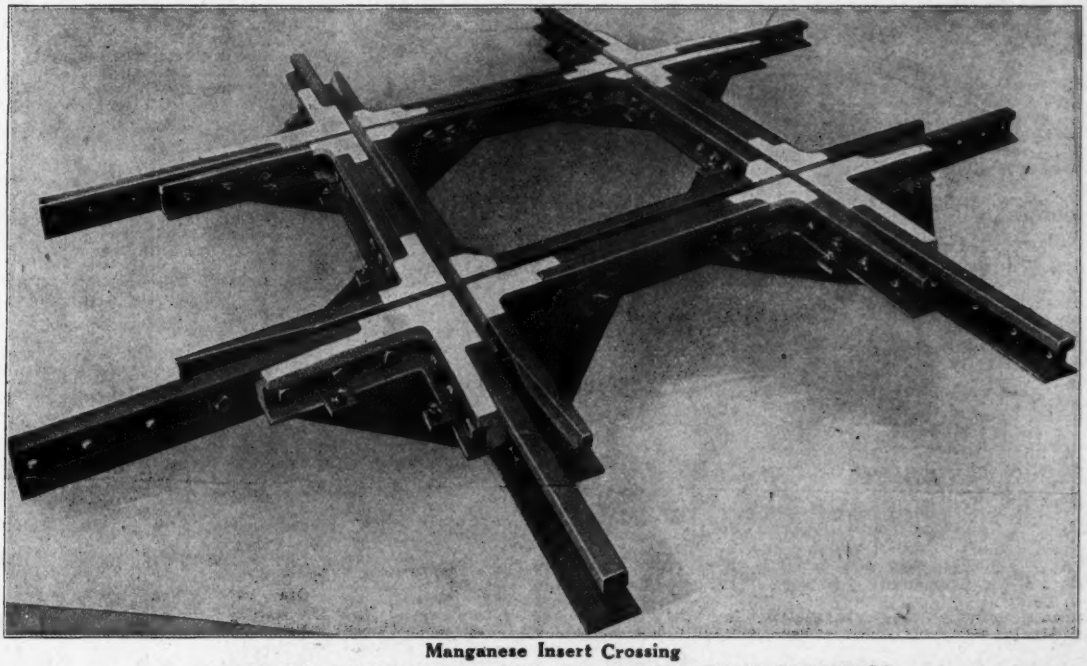

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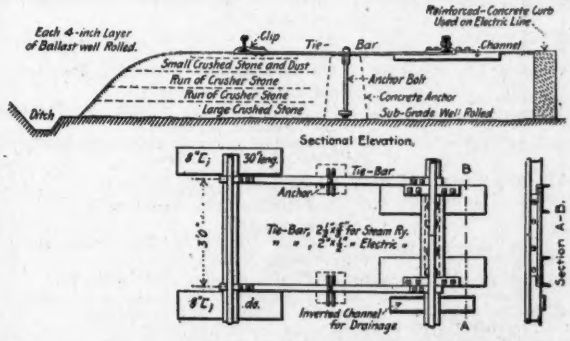
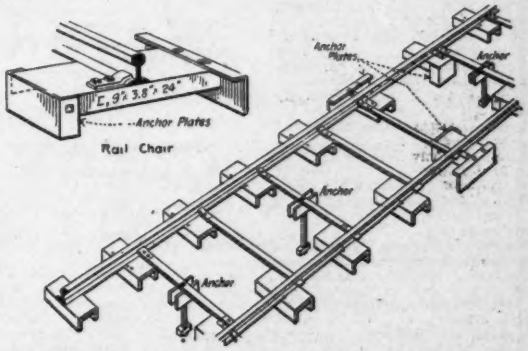


Track Construction with a watertight bed of rolled stone ballast.



Track Construction for very heavy traffic, used in connection with heavily rolled bed of broken stone.

A reinforced compacted monolithic bed or permanent way is a support for the rails and rail chairs. The chairs may be considered under the head of tie plates. My bed represents both the ballast and wooden ties combined. A bed constructed on my plan will answer every condition required of both, and more too. The alignment is permanently maintained, as well as surface and gage. It will admit of the use of anti-creeper appliances. There is a scrapping value in the steel after being used. The bed will not settle out of sight in the soft ground and be lost. It is practically water-tight, and has a tendency to prevent the settlement of embankments. It can be constructed to carry wheel loads of 30,000 lbs. each at maximum speeds.

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Light Inspection Car Co., Hagerstown, Ind.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Mudge, Burton W., & Co., Chicago.

Instruments (Engineering).
Seelig, R., & Sons, Chicago.

Insulation and Insulating Material.
Central Electric Co., Chicago.
Okonite Co.

Lamps and Lanterns.
Gray, Peter, & Sons (Inc.), Boston.

Latches.
Richards-Wilcox Mfg. Co., Aurora, Ill.

Line Material.
Electric Ry. & Equip. Co., Cincinnati, O.

Lock Nuts.
Interlocking Nut & Bolt Co., Pittsburg.

Locks, Sliding Door.
Richards-Wilcox Mfg. Co., Aurora, Ill.

Locomotive Cranes.
Brown Hoisting Machinery Co., Celveland.

Locomotive Replacers.
Johnson Wrecking Frog Co., Cleveland, O.

Locomotives, Industrial.
Vulcan Iron Works, Wilkes-Barre, Pa.

Lubricants, Graphite.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Lubrication, Graphite.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Maintenance of Way Supplies.
Hubbard & Co., Pittsburg.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Manganese Frogs and Crossings.
Cincinnati Frog & Switch Co., Cincinnati, O.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati, O.

Mast Arms.
Electric Ry. Equipment Co., Cincinnati.

Metal Protecting Paints.
Mamolith Carbon Paint Co., Cincinnati, O.

Mining Instruments.
R. Seelig & Son, Chicago.

Molds, Pipe and Culvert.
Concrete Form Engine Co., Detroit, Mich.

Motor Cars.
Associated Manufacturers Co., Waterloo, Ia.
Chicago Pneumatic Tool Co., Chicago.
Concrete Form & Engine Co., Detroit, Mich.
Fairmont Machine Co., Fairmont, Minn.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Mudge, Burton W., & Co., Chicago.

Motors, Gasoline.
Associated Manufacturers Co., Waterloo, Ia.
Concrete Form & Engine Co., Detroit, Mich.
Fairmont Machine Co., Fairmont, Minn.

Nut Locks.
Interlocking Nut & Bolt Co., Pittsburg.

Oil Cans.
Gray, Peter & Sons, Boston, Mass.

Oil Storage Systems.
Bowser, S. F., & Co., Ft. Wayne, Ind.

Oil Tanks.
Bowser, S. F., & Co., Ft. Wayne, Ind.
Wm. Graver Tank Wks., E. Chicago, Ind.

Overhead Carriers.
Richards-Wilcox Mfg. Co., Aurora, Ill.

Paint Sprayer.
F. J. Lederer Co., Buffalo, N. Y.

Paints.
Dixon, Joseph, Crucible Co., Jersey City, N. J.
Mamolith Carbon Paint Co., Cincinnati, O.

Parallel Door Hangers.
Richards-Wilcox Mfg. Co., Aurora, Ill.

Parallel Door Hardware.
Richards-Wilcox Mfg. Co., Aurora, Ill.

Pencils.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Perforated Metal.
Dixon, Jos., Crucible Co., Jersey City, N. J.

Picks.
Hubbard & Co., Pittsburg, Pa.

Pipe Line Carrier Bases.
Universal Railway Supply Co., Chicago.

Pipe, Wooden Water.
Michigan Pipe Co., Bay City, Mich.

Plate. (See Tie Plates.)

Pole Line Material.
Electric Ry. Equip. Co., Cincinnati.
Hubbard & Co., Pittsburg, Pa.

Poles, Steel.
Electric Ry. Equip. Co., Cincinnati.

Post Hole Diggers.
Hubbard & Co., Pittsburg, Pa.

Power Plants.
Gale Installation Co., Chicago.

Push Cars.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Publications.
Clarke, Myron C., Pub. Co., Chicago.

Push Cars.
Associated Manufacturers Co., Waterloo, Ia.

Pumps, Oil.
Bowser, S. F., & Co., Ft. Wayne, Ind.

Rail Benders.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Rail Braces.
Atlas Railway Supply Co., Chicago.
Cincinnati Frog & Switch Co., Cincinnati, O.
Indianapolis Switch & Frog Co., Springfield, O.
Weir Frog Co., Cincinnati.

Rail Joint Clamp.
Track Necessities Co., Chicago.

Rail Drills.
Indianapolis Switch & Frog Co., Springfield, O.

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Rail Joints.
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Rail Joint Co., New York City.
Weir Frog Co., Cincinnati, O.

Railway Equipment and Supplies.
American Valve & Meter Co., Cincinnati, O.
Atlas Railway Supply Co., Chicago.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Industrial Supply & Equipment Co., Philadelphia.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Mudge, Burton W., & Co., Chicago.
Rail Joint Co., New York.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati.

Replacers, Car and Engine.
Johnson Wrecking Frog Co., Cleveland, O.

Retorts, Timber Preserving Plant.
Wm. Graver Tank Works, E. Chicago, Ind.

Right-of-Way Gates.
American Farm Gate Co., Kansas City, Mo.
Iowa Gate Co., Cedar Falls, Ia.

Roofing Materials, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Roundhouse Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Screw Spikes.
Hart Steel Co., Elyria, O.

Section Cars, Gasoline.
Associated Manufacturers Co., Waterloo, Ia.
Chicago Pneumatic Tool Co., Chicago.
Concrete Form & Engine Co., Detroit, Mich.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Mudge, Burton W. & Co., Chicago, Ill.

Sheathing, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Sheet Metal.
Gray, Peter, & Sons, Boston.

Shingles, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Shovel Handles.
Wyoming Shovel Wks., Wyoming, Pa.

Shovels, Spades and Scoops.
Hubbard & Co., Pittsburg, Pa.
Wyoming Shovel Wks., Wyoming, Pa.

Signal Lamps.
Gray, Peter, & Sons, Boston.

Smoke Jacks, Asbestos.
Franklin Mfg. Co., Franklin, Pa.

Spikes.
Dilworth Porter & Co., Pittsburg.
Hart Steel Co., Elyria, O.

Steel Forms.
Concrete Form & Engine Co., Detroit, Mich.

Steel Gates.
Iowa Gate Co., Cedar Falls, Ia.

Steel Plate Work.
Wm. Graver Tank Works, E. Chicago, Ind.

Stone Crushers.
Marsh Co., Chicago.

Storage Batteries.
U. S. Light & Heating Co., New York.

Striking Hammers.
Hubbard & Co., Pittsburg, Pa.

Surveying Instruments.
Seelig, R., & Son, Chicago.

Switch Lanterns.
Gray, Peter, & Sons, Boston.

Switch Rods.
Weir Frog Co., Cincinnati, O.
Ramapo Iron Works, Hillburn, N. Y.

Switches and Switch Stands.
American Valve & Meter Co., Cincinnati, O.
Atlas Railway Supply Co., Chicago.
Cincinnati Frog & Switch Co., Cincinnati.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
Weir Frog Co., Cincinnati.

Switchboard Adjusters.
Weir Frog Co., Cincinnati.

Tank Cars.
Wm. Graver Tank Works, E. Chicago, Ind.

Tanks and Tank Fixtures.
Bowser, S. F., & Co., Ft. Wayne, Ind.
Wm. Graver Tank Works, E. Chicago, Ind.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Telegraph and Telephone Supplies.
Central Electric Co., Chicago.
Hubbard & Co., Pittsburg.

Tie Plate Gage.
Track Necessities Co., Chicago.

Tie Plates.
Atlas Railway Supply Co., Chicago.
Dilworth Porter & Co., Pittsburg.
Hart Steel Co., Elyria, O.

Tie Surfacer.
Track Necessities Co., Chicago.

Tie Tongs.
Track Necessities Co., Chicago.

Tool Grinders.
Track Necessities Co., Chicago.

Timber Preserving Plant Machinery.
Wm. Graver Tank Works, E. Chicago, Ind.

Track Drills.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Track Jacks.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Track Layers.
Hurley Track Laying Machine Co., Chicago.

Track Laying Cars.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Track Materials.
Atlas Railway Supply Co., Chicago.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Indianapolis Switch & Frog Co., Springfield, O.
Ramapo Iron Works, Hillburn, N. Y.
Track Necessities Co., Chicago.
Weir Frog Co., Cincinnati.

Track Tools.
Hubbard & Co., Pittsburg, Pa.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Track Necessities Co., Chicago.
Wyoming Shovel Works, Wyoming, Pa.

Transfer Tables.
Nichols, Geo. P., & Bro., Chicago.

Trolley Brackets.
Electric Ry. & Equip. Co., Cincinnati, O.

Turntable Tractors.
Nichols, Geo. P., & Bro., Chicago.

Turntables.
Nichols, Geo. P., & Bro., Chicago.

Valve Grease, Graphite.
Dixon, Joseph, Crucible Co., Jersey City, N. J.

Velocipede Cars.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Ventilating System.
Gale Installation Co., Chicago.

Washers.
Hubbard & Co., Pittsburg, Pa.
Coes Wrench Co., Worcester, Mass.
Dixon, Joseph, Crucible Co., Jersey City, N. J.

Water Chemists.
Lord, Geo. W., & Co., Philadelphia, Pa.

Water Columns.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Water Coolers.
Gray, Peter, & Sons, Boston.

Water Filters.
Pittsburgh Filter Mfg. Co., Pittsburg, Pa.

Water Purifiers.
Lord, Geo. W., & Co., Philadelphia, Pa.

Water Purifying Chemists.
Lord, Geo. W., & Co., Philadelphia, Pa.

Water Softeners.
American Water Softener Co., Pittsburg, Pa.
Booth, L. M., Co., Chicago.
Wm. Graver Tank Works, E. Chicago, Ind.
Lord, Geo. W., & Co., Pittsburg, Pa.
Pittsburgh Filter Mfg. Co., Pittsburg, Pa.

Wedges.
Hubbard & Co., Pittsburg, Pa.

Wheelbarrows.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Wires.
Central Electric Co., Chicago.

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Central Electric Co., Chicago.

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Johnson Wrecking Frog Co., Cleveland, O.

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An insulated socket wrench to fit R. S. A. binding post nuts.

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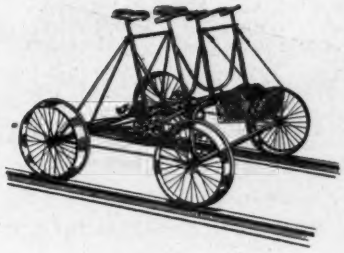
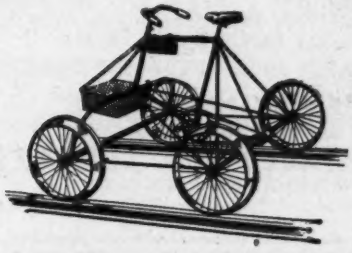
HARTLEY & TEETER





Light Inspection Cars are the Strongest and Lightest running known. The fact that we constantly receive repeat orders is proof absolutely that our cars are giving entire satisfaction. We shall be pleased to supply you with our new catalog that tells all about them.

LIGHT INSPECTION CAR CO.

HAGERSTOWN, INDIANA

Maintenance vs First Cost — For One Gate Opening

The relation of maintenance to first cost as effecting final net returns from a given investment, is frequently not fully appreciated by railway officials who continue to use wooden gates. Why specify and buy four or five cheap gates to fill the same opening in ten years' time, spending the railroad's money (at least $25.00)—also claims paid for "stock killed"—also "continual repairs" on a gate that will not keep stock off the right-of-way, when for one-fourth of the amount railroads can purchase an American Self-Lifting High Carbon Steel Galvanized Gate that will settle the cost and expense for that opening forever? Note advantages of American Railway Gates.

"Drags up Never Down." Horse High. Bull Proof. Fool Proof and Hog Tight. Painted or Galvanized.

Flexible Steel Couplings. Four flexible steel couplings allow the American Railway Gate to "give" without wrenching or twisting when stock crowds against the gate or loaded wagons strike it. No other gate has this flexible-coupling principle.

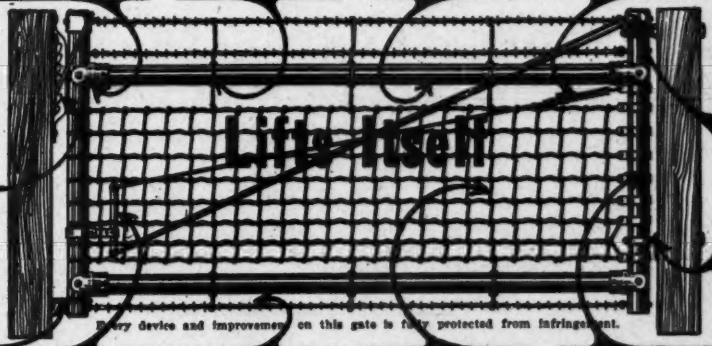
Connections. Flexible connections between the wire covering and steel frame turn and slip, but cannot be loosened by hard usage.

Tubing. Tubing is so strong no extra bracing needed. It is 2 inches in diameter; no other gate tubing is as large or strong.

Helical Lifting Spring. This powerful helical lifting spring is like the springs used on the best farm machinery in strength and quality. The coil wire used is baked, tempered in oil and galvanized, and will stand six times the strain of the gate.

Ratchet Lock. This ingenious ratchet-lock-and-loop locks the gate down, close to the ground, or adjusts the gate when the ground is rooted up by hogs or "heave up" by frost, or when snow is deep.

Fork This hog-yard Fork holds the lower part of gate firmly; stock cannot wrench it out of place.



Bolted Caps. Caps are securely bolted to the frame. All couplings, caps and attachments, like the gate frame itself, are cold-rolled steel, pickled and limed—the highest quality steel made.

Hinge Lock-Nuts. Hinge lock nuts enable you to hang gate plumb, even if the post is out of plumb or uneven. Also 1-inch leeway for the hinge allows gate to rise or settle with freezing or thawing of ground.

Every device and improvement on this gate is fully protected from infringement.

Self-Lifting Equalizer. This automatic equalizer raises the end of the American Railway Gate when the ratchet lock is released. You do not have to lift the gate at all; it lifts itself. No other gate made has this self-lifting principle.

Hog Tight. Barbed wire close to ground and low position of bottom tubing makes it impossible for hogs to root under or through.

Wire Mesh. Note the closely woven wire mesh. Only finest quality American Steel & Wire Company standard wire mesh is used.

Ratchet Stretcher System. The horizontal wiring is tightened and kept rigidly in place by a ratchet stretcher system—the only true principle of tightening the heavy mesh hog wire. Even tension is insured by tightening each wire separately.

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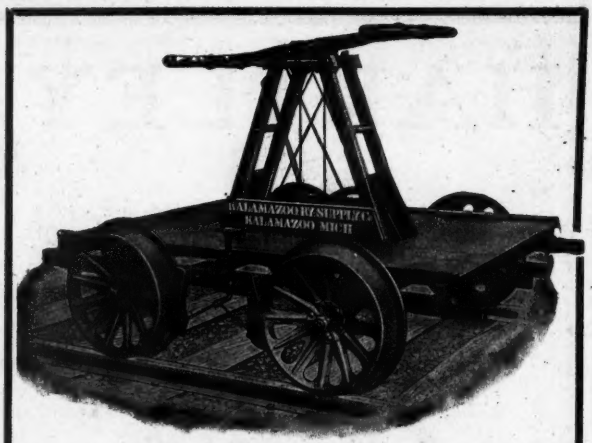
See Offer on Page 113, December Issue of

The Monthly Official Railway List



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are equipped with the Kalamazoo Improved Reinforced Pressed Steel Wheel, giving 50 to 100 per cent greater wear than any other wheel of similar design or weight on the market. The car has stout gallows frame, thoroughly trussed, has taper wheel and pinion fits on axles, machine cut gears, flexible steady box and double acting brake.

16 Different Styles, Standard or Special

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Kalamazoo, Mich.

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A New Book full of up-to-date information for every member of the Maintenance of Way department. It should be in the hands of every trackman who is looking for advancement.

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1—70-ton Bucyrus. Splendid condition. With 2½ yd. dipper.
1—70-C Bucyrus. Good as new. With 2½ yd. dipper.
1—95-ton Bucyrus. Splendid machine. 3½ yd. dipper.

And a great many others. Write for our bulletin.

LOCOMOTIVE CRANES.

1—10-ton McMyler with 38′ boom.
1—10-ton Industrial with 38′ boom.
1—15-ton Interstate with 50′ boom.
1—20-ton Interstate with 50′ boom.

All of the above are equipped for handling two line buckets.

LOCOMOTIVES.

9x14 Porters & Davenports, good condition.
10x16 Porters & Davenports, fine condition.
1—4-wheel, 45-ton Interstate, fine condition.
1—25-ton Porter Saddle Tank Standard gauge.

DRAG LINES.

2—100′ boom, Heyworth-Newman, fine condition.
1— 60′ boom, Class B Lidgerwood-Crawford, good shape.
1— 60′ boom, Monighan and some smaller ones.

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Gyratory and Jaw Crushers, Hoisting Engines, Cableways, Clam and Orange Peel Buckets, Pile Drivers, Mixers, Cars, Air Compressors, Drills, Trench Machines, Pumps, Graders and everything used by contractors.

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PITTSBURGH, PA.

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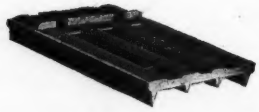

DILWORTH FLANGE PLATE

HARRIMAN PLATE

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Standard and Special Railroad Spikes

Goldie Perfect Spikes a Specialty

Send for new catalogue

THE Merit of "Indianapolis" Products appeals to the discriminating *Engineer* and *Roadway Official*, who is progressive, practical and recognizes the value of Final efficiency and economy rather than low first cost with excessive maintenance and interrupted operating schedule.

He wants to know that all

Materials are strictly and absolutely first quality throughout.

Nothing but first quality rails and fittings go into any part of our product.

Nothing but American "Stag" Brand of manganese (the most dependable and serviceable metal of its kind yet produced) is used in our manganese work and in combination with scientific designing and liberal sections with a maximum safety factor—

Nothing is better (no exceptions).

He wants to know that

Workmanship and Methods are confined to the best modern practices only.

Our works are located at Springfield, Ohio.

We have every modern and improved facility for the most economical production of strictly High Class Product.

But employ no practices or methods to lessen the cost of production that are in any way detrimental to the steel or other material.

All rails are drilled—never punched.

All bolted structures are UNIT DRILLED and bolts a driving fit.

All rivets are compression driven—70 tons maximum pressure.

All manganese is accurately fitted and ground at a low temperature.

Result—Costs some more—worth much more.

He wants to know that

Design embodies strength and endurance and eliminates weakness and failures.

"Conservation of Energy" is a science which applied to Track and Rolling Stock has done more than any other one thing to bring into favor and recognition the "Indianapolis" Designs and their adoption by the leading and best roads in the country.

Our designs are the results of our own experience and observation together with a composite of suggestions of the most able Engineers and track men.

Designs that favor and protect both the structure and rolling stock.

Indianapolis built up designs of Regular Construction are reinforced and self-contained, prolong the life of the work.

Indianapolis R-N-R Designs of Manganese Frogs and Crossings have revolutionized maintenance and when introduced were a radical departure from any known practice, yet have been freely adopted and are extensively in use on nearly all roads of importance where purchases are not restricted.

Indianapolis R-N-R Designs have features of exclusive merit not found in any others.

Indianapolis Manganese Designs of Insert Special Work, were the first to feature the renewal of rail parts without removing from the track for repairs.

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where to get what he needs.

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